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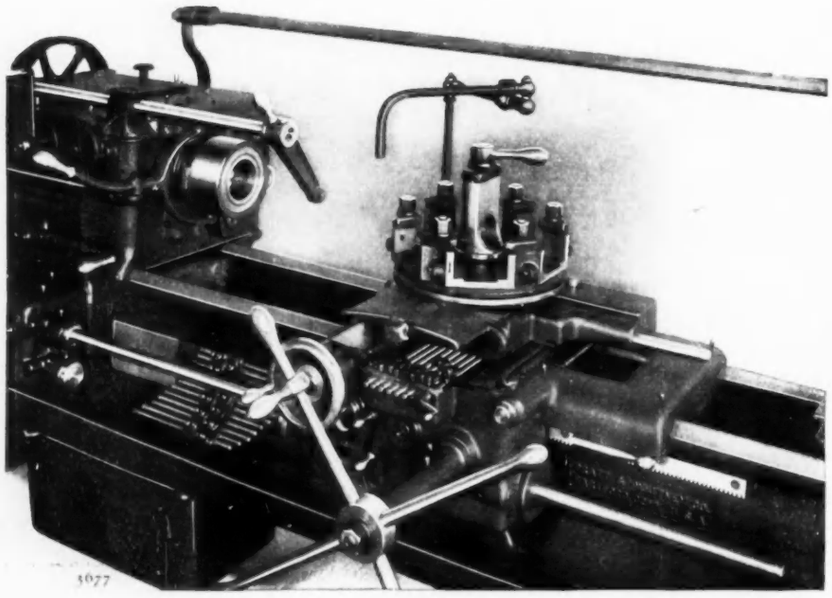

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(*See pages*, 43, 44, 45, 46, 47 *and* 48)

Telling Time by Automatic Machinery

Some Clock Devices Which Are Within the Field of Engineering. Master, Secondary, Self-winding and Synchronized Clocks. "Minute Jumpers"

BY SNOWDEN B. REDFIELD

Every home has at least one piece of more or less high-grade machinery to assist in the proper regulation of household affairs. By this piece of machinery is not meant either the sewing machine or the mon to practically every household is the ordinary domestic clock.

Few people consider the clock as a piece of machinery, especially when gotten up in the cheap forms which are now so are becoming more and more commercially popular in the effort to provide uniform standard time throughout the country show in their ingenious make up the inventive mind of the trained engineer.

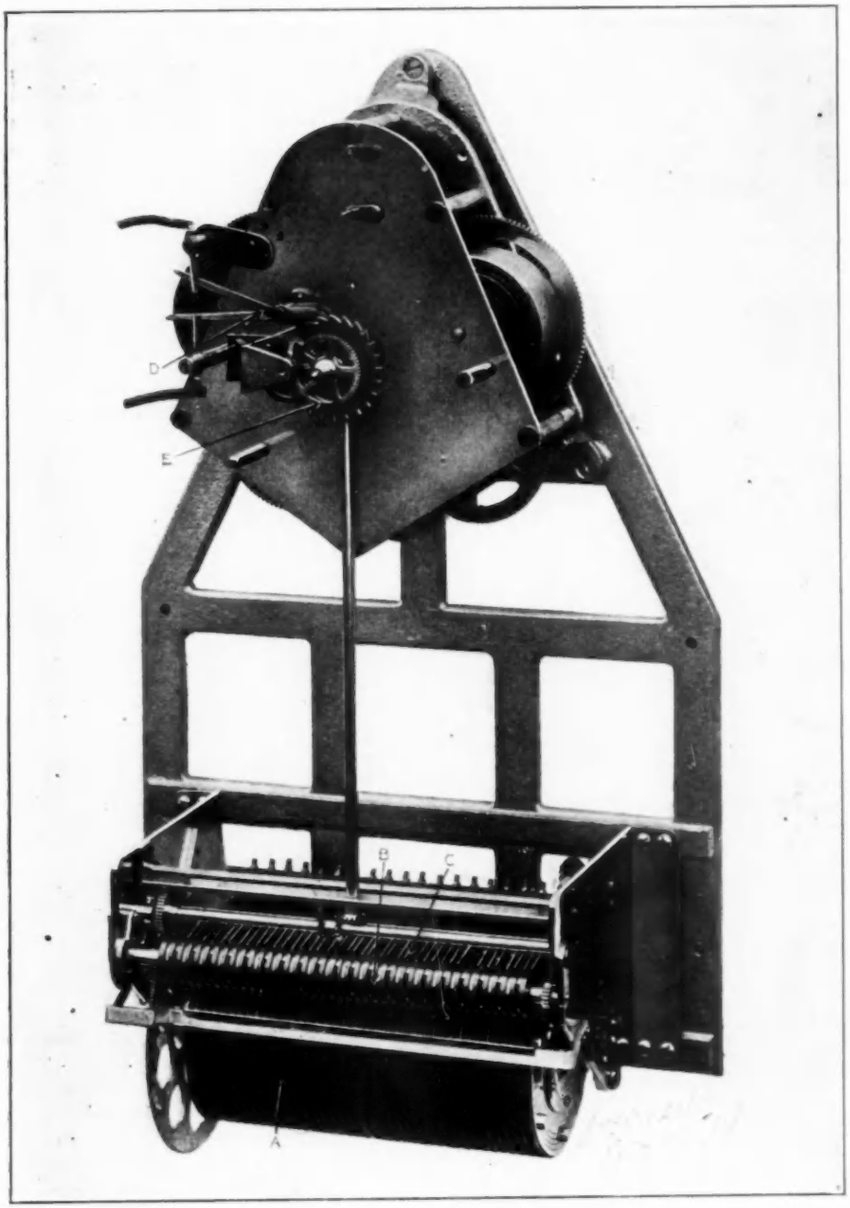


FIG. 1. PROGRAM CLOCK MECHANISM

A, main contact cylinder. *B*, cam roller to control contact brushes. *C*, contact brushes. *D*, scissor switches. *E*, motion gearing.

lawn mower, because these two devices require constant attention during their operation and the reference is to automatic and semi-automatic machines. The piece of semi-automatic machinery which is com- universal. It is a fact, however that the principal clock builders employ skilled engineers, both electrical and mechanical, in the turning out of their products, and some of the automatic clock devices which

Accurate or Uniform Time

Importance of accuracy of time measurement is well appreciated but a moment's thought will indicate that the harmonious running of a large establishment such as a manufacturing concern or a school, each with many separate departments, depends more upon uniformity of time in all departments than upon absolute accuracy. If simultaneous actions in different parts of a large establishment are dependent upon the clock, it is necessary that the clocks in all departments shall tell exactly the same time.

Under old-style methods this result could be secured only by using many high-grade clocks, each very expensive and even then liable to vary one from another. The modern way to accomplish this result is to install one high-grade accurate master clock which will automatically regulate any number of secondary clocks throughout the establishment so that they will all exactly agree. This automatic regulation can be extended to include the employees' time recorders in all parts of the plant, the watchman's time detectors and even the time stamps in the offices.

In many of these establishments, especially schools, it is also necessary to ring signal bells at certain intervals for the changing of classes, etc., these programs often varying for different parts of the day and for different days of the week. The ringing of these bells is accomplished by what is known as a program clock which may be so arranged as to automatically care for almost any schedule.

One form of secondary clock controlled by a master clock is met with by every traveller, that is, the clocks so often seen in railroad stations which, it is proclaimed, are corrected "hourly." If one happens to glance at one of these clocks on the even hour, he will notice that at this time the hands will suddenly jump and stand rigidly at the hour for a few seconds. These are known as secondary, synchronized clocks and they are all set or synchronized once an hour by a central master clock of high-grade construction.

Another common term in the modern clock field is the self-winding clock. These clocks, as the name implies, do not

need to be wound by hand as they receive their energy from electric batteries, or from an electric power line. Master clocks may be either weight or spring operated, or self winding, and by their high-grade construction they keep accurate time and also synchronize any number of secondary clocks which may be on the same electric circuit with them.

There are three varieties of secondary clocks. The secondary clock may be weight or spring operated and synchronized once an hour by the master clock, or it may be of the self-winding variety, also synchronized once an hour by the master clock. These synchronized secondary clocks are provided either with a pendulum or balance wheel. The third style of secondary clock is vulgarly known as the "minute jumper." These latter devices can hardly be classed under the name of clocks at all, for the mechanism inside of the case is extremely limited. In these minute jumpers, the hands move only once a minute and thus the minute hand travels around the hour in 60 evenly spaced jumps, standing at any one minute stock still until another minute has elapsed. The jumping impulses are all sent out by the master clock and, as said, any number of secondary clocks of this character or, for that matter, of any one of the three types of secondary clocks can be controlled by one master clock.

Program Clocks—the Bell Ringers

To go into the matter of the program clock which is so common to any modern school system, an examination of Fig. 1 will reveal the general appearance of the inside workings of such a device manufactured by the Prentiss Clock Improvement Company, of New York City. This clock is usually of the weight- or spring-wound variety, often of the 60-day type, and its function is not only to keep accurate time but also to ring any number of bells according to practically any prearranged time schedule. The program clock may also at the same time operate any number of secondary clocks either by synchronizing them once an hour or by operating them as minute jumpers. In this way one expensive high-grade central time piece controls the movements throughout a large school building for changing classes, assigning lessons, beginning recitations, announcing recesses, etc., and, what is clearly seen to be most important, also provides accurate time on the secondary clock in each individual room.

Study of the diagram Fig. 2 will show the operation of the program system. The cylinder at the bottom, as shown in Fig. 1, is illustrated in the diagram as a circle or disk having a serrated edge. The cylinder is made up of several of these serrated disks, which are made of thin sheet copper, placed side by side on the same axis, but separated from each other by fiber spacers. The length of the cylinder depends upon the number of disks which there are in the arrangement. Resting upon the serrated points of the disks, as shown in the diagram, there are electric contact brushes and these serrated copper disks are also in electric contact with the shaft of the cylinder and so with the framework of the mechanism. The cylinder is driven by the clock mechanism, the ratio of the gearing being such that one of the serrations or contact points on the disks passes under the brushes every so often, say once in five minutes or once in one minute, depending upon the schedule desired. The brushes bearing upon the little contacts lead to the automatic scissor-shaped switches shown in the upper part of the diagram and also shown in the halftone, Fig. 1. Farther on these electric circuits pass through the battery and through the various bells to be rung. These are connected in parallel with each other. If there are many bells they will be rung by a relay which does away with a heavy current in the program mechanism. Electric condensers are also provided to eliminate sparking and burning of the contacts due to high inductance in a circuit having many bells.

The serrated contact points on the disks being of thin copper are easily bent down sideways so that they will not come in contact with the electric brushes bearing upon the circumference of the disks; and when they are bent down, the brushes rest upon intermediate fiber disks so that no electric contact is made. Only those points left standing will make electric connection with the brushes as the disks turn around. In this way there being one contact for each unit of time, as selected, by turning down certain contacts and leaving certain others standing up, the electric contact can be made just as often throughout the day and at just as regular or irregular intervals as may be desired.

Cutting Electric Currents with Scissors

Of course the cylinder turns comparatively slowly, and it takes some little time for the contact points to traverse under the contact brushes. This would lead to very slow making and breaking of contacts, causing sparking and burning of the contacts themseves, and also would continue the ringing of bells possibly for five minutes or more. These objections are overcome by the use of the little scissor switch already mentioned. The office of this switch is to make and break the electric circuit with a quick snap and also to cut down the duration of the flow of the current and the continued ringing of the bells. This can be regulated so that the bells will ring for five, ten, or 15 seconds, as may be desired.

These little switches, as their name im-

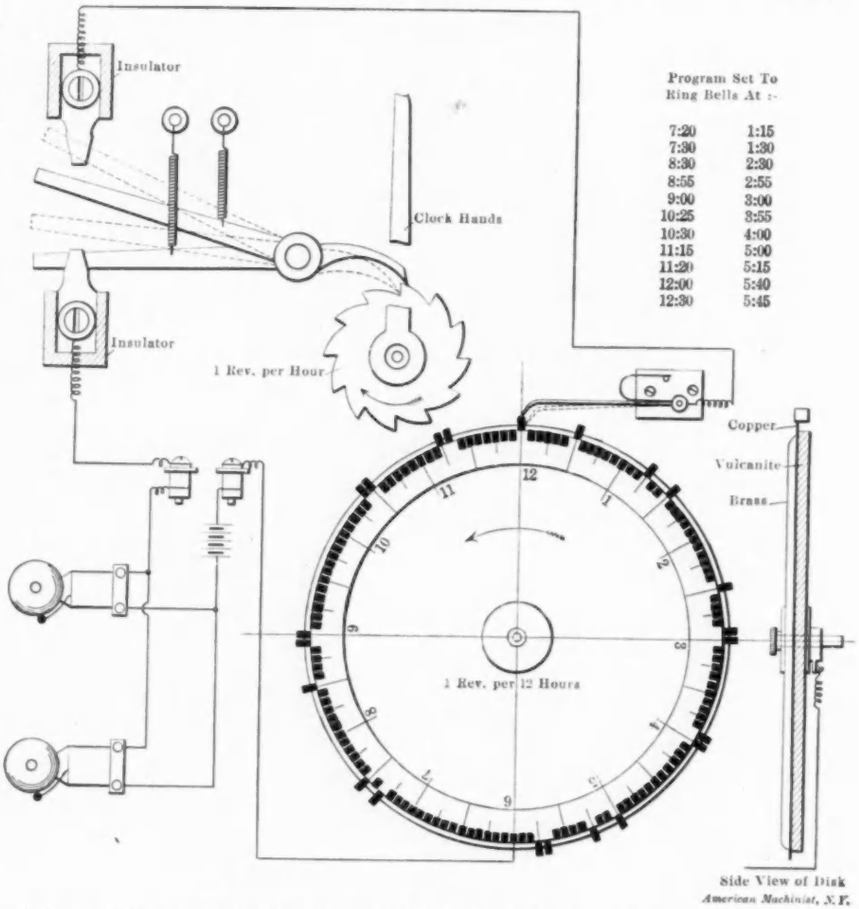


FIG. 2. DIAGRAM OF SINGLE DISK 12-HOUR PROGRAM MECHANISM WITH 5-MINUTE TIME UNITS

plies, are composed of what closely resemble the two blades and handles of a small pair of manicure scissors. When the scissors are open the upper handle makes electric contact with the little knife switch above it and the lower handle makes another electric contact with a knife switch below it. The blade ends of the scissors are raised up and dropped down by the teeth of the circular-saw shaped cam which is rotated by the clock mechanism.

FIG. 3. ANOTHER PROGRAM CLOCK

A, lever to operate *B*. *B*, cam roller to control brushes. *C*, star wheel to skip Saturday and Sunday.

One of the little blades of the scissors is shorter than the other by a fractional amount. Consider now that in the diagram of Fig. 2 the circular-saw shaped cam revolves to the right. This lifts up both of the scissor blades and consequently drops down both of the scissor handles, the handles remaining apart a distance slightly less than the distance between the upper and lower knife switches mounted on the frame. Thus it is seen that, while the blades are rising and the handles descending no electric contact is yet made. However, when the scissor blades have about reached the top of the saw tooth on the cam, the lower handle does come into electric contact with the lower knife switch but as the upper handle does not touch the upper switch, still no current flows. The upper handle is the one which is connected to the scissor blade which is slightly shorter than its mate.

As the circular-saw cam continues to revolve to the right, there will come a time when the short scissor blade will slip over the end of the saw tooth and by the action of the spring this blade drops quickly down and the handle flies up, striking the upper knife switch and completing the electric circuit from one switch to the other through the two scissor handles and their central common pivot.

While the parts are in this position the electric current is flowing and the electric bells throughout the building are all ringing. While this is going on also the circular-saw cam is continuing to revolve in the same direction and within a very short interval the other scissor blade, which is connected to the lower scissor handle, also slips off the end of the saw tooth, and by the action of a spring the blade flies down and the handle flies up, breaking the electric contact on the lower knife switch. This immediately cuts off the electric current and stops the ringing of the bells.

It is now seen that while the contacts of the serrated points of the main copper disks with the contact brushes bearing upon these points are of considerable duration, the circuit is only completed when the scissor handles are sprung apart, coming into contact with the two knife switches, thus accurately and instantaneously controlling the time of the flow of the electric current. These little scissor switches fly open and shut, making their knife-switch connections every so often; that is, every five minutes, or every one minute, according to the minimum time unit selected, but the bells do not ring unless while these scissor switches are open, the contact brushes bearing on the disks are in actual contact with one of the raised projections on the disk, thus completing the electric circuit.

Dividing the Day's Work

Why have so many of the little serrated disks side by side on the cylinder? The number of these disks depends upon what schedule it is desired to carry out, and, as a rule, only one of these disks is in electric contact with the circuit at a time, although when there is more than one circuit there is, of course, a set of disks for each circuit, provided the program is not alike on the several circuits. The cylinder and the disks must revolve at some convenient speed in order to make the contact points of convenient size, and so when the schedule requires frequent signals it has to be divided up into a number of disks, one disk taking care of part of the day, say, three hours, from 12 to 3, the next disk continuing the program from 3 to 6, and so on throughout the 24 hours.

All the contact brushes connecting with any one bell circuit are hung upon a common shaft at the fulcrum end and are short-circuited on each other, so that some provision must be made allowing only one brush for each circuit to come in contact with its revolving disk at a time. This

brush is that which presses upon the disk controlling the program for that particular portion of the day's operation.

In order to control these contact brushes, a small roller, seen in Figs. 1 and 3, just above the cylinder comes into play. This roller contains a series of cams, one cam for each contact brush. Under normal conditions the cam lifts up the brush so that it does not press against the disk, but there is one cam for each disk which for any one position of the roller will allow the brush over that disk to drop down and rest upon the contact points. Every time the cylinder revolves once a pin on the cylinder moves a ratchet lever which revolves the upper roller a given portion of a revolution, and this revolution of the roller lifts up the brush or brushes which have just been in operation and drops down the next set to bear upon the next following disk to carry on the program. This continues throughout the day, each brush operating to ring the bells according to the disk upon which it is allowed to rest, depending upon the position of the cams on the upper roller.

Saturday and Sunday Rest

In most schools the bells would not be required on Saturdays and Sundays, and during this time the circuit is automatically disconnected from the apparatus by the operation of the small star wheel at the right end of the cylinder. This star wheel has seven points, and as the upper roller revolves once each day it turns this star wheel one-seventh of a revolution. On Saturday the star wheel will have reached such a position that a cam located on its axis will lift up a little lever, opening a knife switch in the main circuit cutting off the bells. On Sunday the knife switch will still be held open, but on Monday morning again by the turning of the star wheel by the roller the circuit is thrown into connection and the program continued. In boarding schools it is usual that certain bells have to ring on Saturdays and Sundays, but their schedule is, of course, entirely different from the ordinary school day. This latter arrangement is secured simply by having a separate set of contact disks thrown into the electric circuits to carry out the program for these days.

When the programs are simple and not more than four contact disks are required, the cylinder is substituted by a short drum which is fastened directly onto the clock mechanism, thus making the apparatus much smaller. The hourly or daily change in the schedule is secured by different disks as before, and they are controlled by a star wheel carrying properly arranged contacts. There is practically no limit to the number of changes of program which may be provided, and these have been built by the Prentiss company, to include 42 disks, this being necessary for providing a contact for each minute of the day for seven days a week, and operating several separate circuits from the same mechanism.

Master and Synchronized Secondary Clocks

So much for the program arrangement. It has been said that an accurate clock may act as a master clock to drive or synchronize any number of secondary clocks. What is the synchronizing mechanism? In the master clock there is provided a little scissor switch already described, this scissor switch operating once an hour. In the secondary clock the hands, while rigidly connected to each other as usual by the "motion gearing," which gives the ratio of 1 to 12 between the hour and minute hands, are mounted upon a friction sleeve sliding over the driving shaft of the clock. By this means the clock may continue to run while it is perfectly possible to change the hands to any position from some external source. This is common to any of the old-fashioned clocks whose setting was accomplished by turning the hands with the fingers.

Upon the sleeve axis of the minute hand of the synchronized secondary clock there is a modified heart cam. Into the depression of the heart when the minute hand is close to the even hour there will fit a wedge which is lifted up by a lever controlled by an electromagnet. With the operation of the magnet the wedge is forced into the depression in the heart cam, and if it strikes anywhere within the curvature on either side of the central line, it will turn the cam and consequently the hands of the clock, to a slight degree, so that the wedge will fit down into the bottom of the depression. When the wedge is in the bottom of the depression, the hands are held rigidly at the even-hour point.

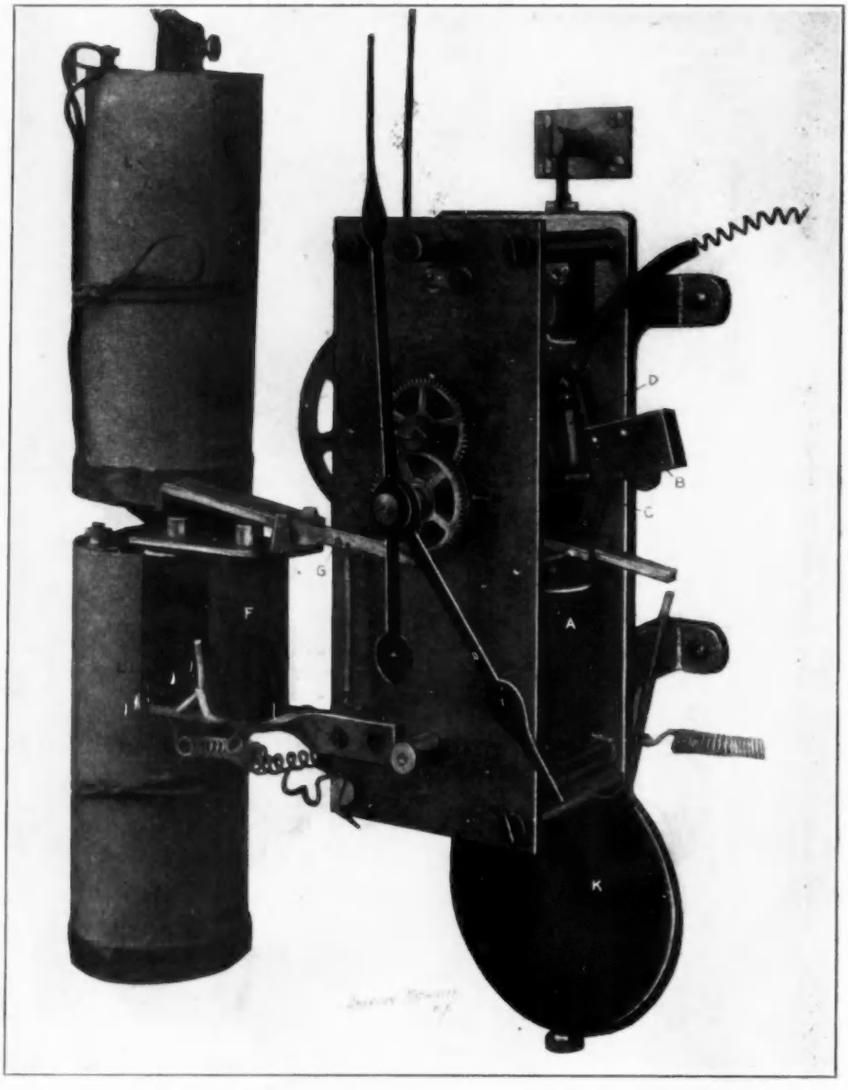


FIG. 4. SELF-WINDING SYNCHRONIZED SECONDARY CLOCK

A, electromagnet for lifting *B*. *B*, weight to operate clock. *C*, auxiliary lever. *D*, knife switch for *C*. *F*, electromagnet for synchronizing. *G*, armature lever carrying synchronizing wedge. *H*, heart cam. *K*, clock pendulum. *L*, winding batteries.

Setting every Hour

Synchronizing is simply that just be-

fore the even hour the master clock by means of a scissor switch sends out an electric current from a few cells of dry battery which forces the wedge on each of the secondary clocks in circuit into the depression in the heart cams. All the minute hands of all the secondary clocks then jump to the even-hour point, and are rigidly held in that position. Just at the time when the even hour is passed, the electric contact is broken in the master clock by the scissor switch; all the electromagnets release their grip upon the levers and wedges which in turn release the heart cams and the hands of the secondary clocks so that the latter continue to travel onward by the ordinary operation of the clock mechanism within themselves, each clock starting the hour at exactly the same instant. This synchronizing will take care of a time variation of one and a half minutes fast or slow, so that even with the crudest kind of secondary clock the electric synchronizing circuit could be out of order for a considerable length of time without becoming ineffectual when started again.

Do Not Need Winding. Perpetual Motion at Last?

Self winding clocks have been mentioned. These may be either master or secondary synchronized. In some forms of self winding clocks an electric motor is used to wind up a short spring at frequent intervals, this electric motor, of course, adding to the expense of each self-winding clock, whether it be of the master or secondary type. In the style of clock illustrated in Fig. 4, driving is done by a very small brass weight mounted on the end of a lever. This is seen at the right in the halftone. The weight bearing the lever down operates a little ratchet and pawl which turns the main wheel of the clock, drives the gearing, operates the pendulum and turns the hands.

When at the end of about five minutes the little weight has reached the bottom of its travel a secondary lever mounted on the main lever strikes against a pin and is gradually raised up until it forms contact with a small electric knife switch on the main lever. This contact throws an electric current through a pair of electromagnets which draw down an armature. This armature in turn strikes against the opposite end of the weighted lever, thus throwing the lever with considerable force and raising the weight on the driving end. As the weight is thrown upward, the little secondary lever which first made the electric contact strikes against a second pin and the momentum of the rising weight throws out the little knife switch so as to break the electric contact. The armature then falls away from the electromagnet and the little weight is again allowed to bring all its pressure to bear upon the main driving wheel of the clock, continuing its operation.

The secondary lever to form the electric contact is necessary because if the main lever formed the contact the lever and weight would be jumping up and down continuously like the vibrator on an electric bell. It is necessary, therefore, by means of a secondary lever to have the electric contact continue during the time that the weight is being raised by the electromagnet, and after the raising has been completed, the contact is broken as said by the action of the momentum of the rising weight. Electric power to drive these self-winding clocks is furnished by three ordinary dry-battery cells such as are used for ringing an ordinary front-door bell.

This arrangement works nicely for secondary clocks which are synchronized once an hour by a master clock, but it will be realized that if the clock is not being driven during the very short interval while the weight is being raised by the electromagnet, one beat of the pendulum may be lost. If this occurs once in five minutes or once in two and a half minutes throughout the 24 hours, the close regulation of the clock, which regulation is accomplished by the adjustment of the pendulum, is a practical impossibility.

It is possible, however, to use this little weight mechanism of the self-winding device for driving the master clock with the highest degree of time accuracy, and this device is used for master clocks by the interposition of a small spring link between the driving lever and the main gear wheel of the clock. When the weight is bearing down the driving force is transmitted perfectly by the spring. Now, when the weight has reached the bottom of its travel and is suddenly lifted up by the electromagnet, the spring between the lever and the main gear wheel will expand so as to continue the pressure of the weight through the spring onto the gear wheel, or rather the spring pushes against the gear wheel so as to assist in the raising of the weight. In this way the actual pressure transmitted to the clock mechan-

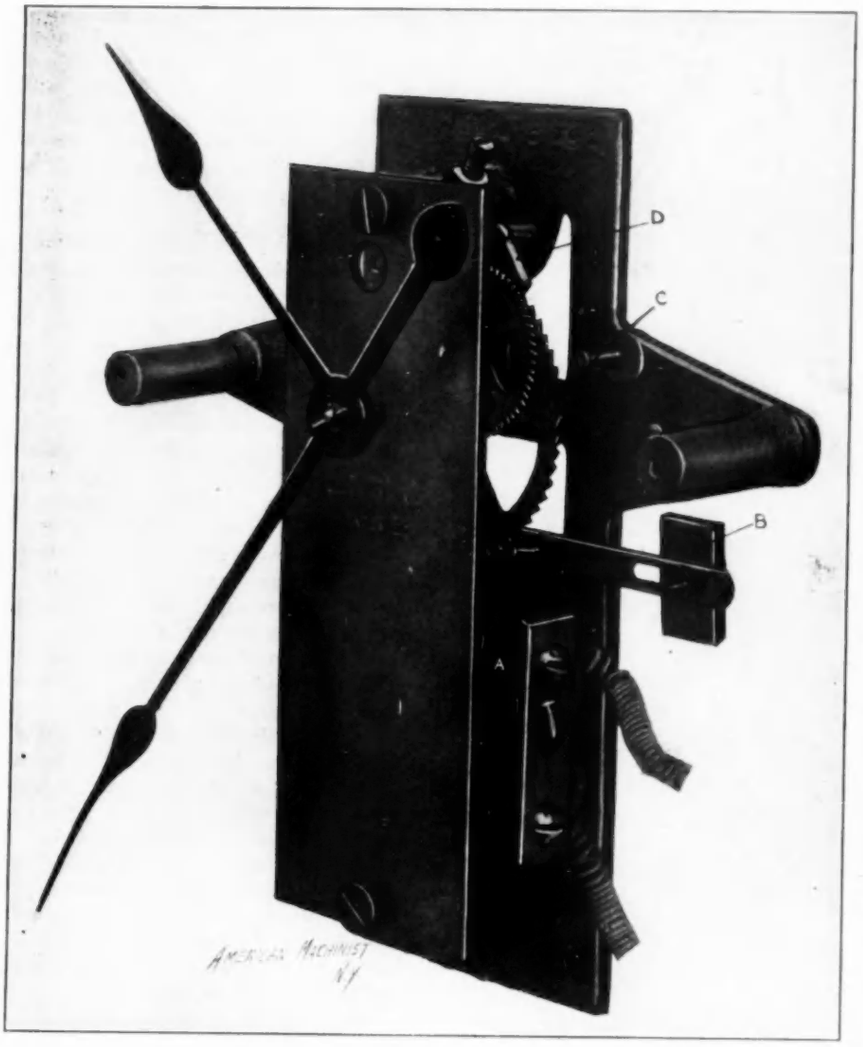


FIG. 5. A "MINUTE JUMPER" SECONDARY CLOCK

A, electromagnet for lifting *B*. *B*, weight to operate ratchet and pawl. *C*, main ratchet wheel. *D*, non-reverse pawl.

ism is practically the same, no matter whether the weight is rising or falling, for the compression and extension of the spring are relatively small. This spring needs no winding; it is simply a flexible link in the power transmission.

Time Goes by Jumps

Minute jumpers might be characterized as rudimentary clocks. The mechanism of a minute jumper, unlike the self-winding clocks, whether secondary or master, is not provided with any pendulum. Their driving mechanism consists of an electromagnet, which receives an impulse of an electric current from the master clock once a minute by a pair of scissor switches in the master clock.

This electric impulse draws over the armature of an electromagnet, which in turn operates a ratchet and pawl on the main gear of the secondary clock. The drawing over of the magnet armature moves the pawl so as to take another step on the teeth of the ratchet wheel, and at the instant the current is cut off, the pawl lever is operated by a little weight so as to push the ratchet wheel around one notch, corresponding to one minute interval on the minute hand. A second pawl assures that the gear wheel does not turn backward, and furthermore, the forward motion of the driving lever forces its pawl under a stop pin in such a way that while in the forward position the ratchet wheel is absolutely locked against turning farther. This prevents any over-travel of the hands due to their momentum, for the operation of jumping from one minute to the next is quite sudden, and unless the hands were positively stopped on each minute, they might travel around several minutes at a time.

Further provision is also made so that the hands are locked in both directions during the time that the driving mechanism is drawn back and before it is released to be forced forward by the operating weight. This system of three locks effectually prevents the hands from moving except at the proper instant, and then limits their motion to the space of one minute at a jump. No synchronizers are, of course, necessary with these minute jumpers, as they are set once a minute, and the master clock may be either of the spring-, or weight-wound, or self-winding type. If the latter, it will be provided with the small spring link between the operating weight and the main gear, so as to insure the highest grade of time-keeping.

Minute jumpers have an advantage over a synchronized secondary clock principally where, as in a factory, there might be excessive vibration which would stop a pendulum clock. The minute jumper is also simpler than a set of self-winding synchronized secondaries in that a whole set of the former may be operated by one set of dry cells, none being required for synchronizing.

FIG. 6. A DESCENDANT OF THE "GRANDFATHER CLOCK"

A, actuating wheel. *B*, auxiliary wheel for skipping the 31st. *C*, cam for skipping 30th. *D*, cam for skipping the 29th of February. *E*, wheel for adding February 29 in the leap year. *F*, trigger operated by clock. *G*, trip moved by teeth of *A*.

Grandfather's Clock Outdone

Most of us have seen the celebrated and long familiar "grandfather clock." The majority of these old clocks were provided with a calendar hand which would tell the day of the month. Others also told the day of the week, and still others had a window cut in the upper part of the dial through which could be seen a "humanized" moon face slowly moving across the opening. This was supposed to give the phases of the moon.

In almost every instance if the calendar mechanism was not out of order, the moon mechanism certainly was, and furthermore, the calendar mechanism, nine times out of ten, was of the slow-moving variety, so that in the evening it was almost impossible to tell whether the date was the 25th or 26th, because the hand was very nearly half way between. It is, however, probable, that in the old days when our great-great-grandfathers used to go to bed early they had no occasion to look at the clock when the calendar hand was half way between the date numbers, so that they were never troubled by this paradoxical state of affairs.

In these old devices, moreover, the calendar mechanism included 31 days in the month, and if the month had only 30 days, or if it was February, with 28 days, it was necessary for the master of the house to be particular at the first of each month to set the calendar hand, so as to give the correct date.

Since the times of our great-great-grandfathers, with their characteristic style of clock, there have been many improvements made in clock-operated mechanisms. Fig. 6 is an illustration of such a mechanism, a clock calendar which, it is claimed, is quite a popular article. The ingenious feature of this calendar clock is that not only does the mechanism automatically take care of months having 31 days and 30 days, but also cuts down the length of the month to 28 days for each February.

No Fear of Leap Year

Aside from this, this apparatus is provided with a mechanism which, every four years, will automatically add another day to the February calendar, giving it the 29 days required by leap year. Furthermore, this mechanism need be wound only once a year, this operation being performed presumably at the time when New Year's resolutions are recorded. It is not stated that there is any automatic mechanism provided for the insurance of the carrying out of these New Year resolutions. This feature seems to be lacking.

When the calendar mechanism, illustrated in Fig. 6, is placed inside the clock case, it is, of course, possible to see only one date at a time; that is, one day of the week, one month, and one day of the month. The movements of the various names and figures are intermittent, so that the calendar moves only at midnight. All the rest of the time the names and figures stare steadily out of the windows in the clock case, so that there need be no uncertainty about knowing the exact date, no matter how late one may sit up at night.

Driving of this apparatus is accomplished by a spring in the bottom entirely independent of the clock spring. The release mechanism, however, is controlled by the clock, which at midnight presses down on the lever stretching over the top of the mechanism which sets the apparatus in motion.

Moving of the calendar mechanism is produced by the large wheel at the bottom. This wheel as seen, is provided with 31 ratchet teeth in its periphery; that is, one for each day of the month. There is also one other tooth space left blank. The blank one is necessary because while there are only 31 dates, there is room on the date cards for 32 dates, as there is a date on each side of the card. By this arrangement, the cards turning over once a revolution and using both faces, 16 cards will do for a whole month, instead of using 31 cards, thus greatly simplifying the mechanism.

On the side of the main ratchet wheel will be seen smaller auxiliary ratchet wheels. One of these is centered on one of the spokes of the main wheel between the hub and the rim. In a similar position on the first small auxiliary ratchet wheel there is a second wheel which is centered on the face of the first auxiliary wheel. In the rim of the first auxiliary wheel there are depressed and raised sections which by the motion of the large wheel are moved into position, one section for each revolution of the large wheel. The ratchet teeth in the large wheel are for the turning of the days of the month, one day for each tooth. The days of the week, of course, turn one after the other throughout the year, and the months are changed one month for each revolution of the large wheel.

The object of the small auxiliary ratchet wheels is to alter the number of teeth in the large wheel to correspond to the number of days in the month. When there are 31 days in the month, the 31 teeth in the large wheel are not interfered with by the auxiliary wheels so that the day of the month mechanism is operated 31 times for that month. The 32d space being blank does not affect the date. For a 30-day month, it is so arranged that by the motion of the first auxiliary wheel a raised section is moved to fill up one tooth space of the main wheel so that the mechanism slides over this tooth skipping the 31st of the month and turning the calendar to the first.

In February the auxiliary wheel is so turned that it automatically raises two small lever cams to fill up the spaces in the large wheel corresponding to both the 29th and the 30th of the month. The tripping mechanism slides over the 29th, 30th and 31st of the month, and skips from the 28th of February to the 1st of March in ordinary years. Now, however, when a leap year comes around, it will be found that the second auxiliary wheel has pulled out a small pin which allows one of these lever cams to drop down, opening up the space in the rim of the main wheel corresponding to the 29th of the month, so that the mechanism will operate for the 28th and the 29th, then skipping the 30th and 31st and turning to the 1st of March.

No provision is made for skipping this day once in 400 years, when leap year is omitted but it is not probable, judging from our "grandfather clock" records that the apparatus will last that long under ordinary conditions. This feature, therefore, will hardly be missed.

Taking Father's Watch Apart

With this clock calendar there is given a circular describing the method of setting, but as one can discover only once in four years, whether or not the calendar is correctly set, it is well worth while not to trifle with it after it comes from the hands of the expert. The fact is, however, that the mechanically inclined person has hard work to keep his hands off such a device as this until he has learned to respect it.

It is said also that in the case of the program clock, especially in the high schools where there is usually a physics professor, this latter gentleman is found to be especially anxious to discover how these mechanisms work. To guard against the depredations of these investigative temperaments, it has been suggested that a small placard be put inside of each clock reading as follows: "Ordinary people will not, and physics professors must not, attempt to find out how these clocks work by taking them apart."

According to the Geological Survey, the United States leads all other countries in the conversion of raw asbestos into manufactured products, although much less than 1 per cent. of the material used is mined in this country.

Why the Cutters Gave Cause for Trouble

The telephone rang sharply, and in answer to the "Hello" a disgruntled inquiry as to where the cutter man was brought him quickly.

"What's the trouble," he asked?

"That concave cutter you just reground for us won't stand up; it's no good."

"Just as you say; we will send a man over tomorrow to see what's the matter."

So in the morning a man arrived at the shop where the trouble was and asked to see the cutter.

It was dull; there was no disputing that. But what made it dull when he knew that its quality was all right puzzled him.

He noticed the cutter was not supported as firmly as it might have been, but that was not the reason.

He looked at the lubricant and with the suspicion that he had found the cause asked the operator what that stuff was.

"One box of washing soda to three pails of cold water," he replied.

"Good. Mix up three or four barrels of that sort of stuff and you won't have a sharp cutter in the shop."

With these words the man who had been sent to look into the trouble dismissed the affair from his mind, and then went to the superintendent to clarify his thoughts as to what lubricant is and is not.

Several days after, however, another telephone call from the same concern aroused the cutter man.

It was a convex cutter that was causing trouble this time and without extended conversation he promised to help them out.

The same man was sent that had given the good advice before and another short investigation proved that what this concern needed was not new cutters but rather cutter experience.

He found them employing a bent arbor which permitted less than half the teeth to cut, and the castings were covered with core sand.

Asked if they ever pickled their castings, the operator replied that he thought the cutter ought to take care of what sand there was there.

But the sand was so thick that the surface to be milled was invisible.

When the expert, for he considered himself such if work of this nature was permitted in shops today, left the superintendent, he wondered whether milling had yet become a universal art.

Query: If shops that profess to do good work employ washing soda for lubricant, bent arbors poorly supported, and sandy castings, what chance has a cutter of good quality anyhow?

Aeroplane Records up to August 29, 1909

By Augustus Post*

In last week's issue of the American Machinist beginning on page 515 I reviewed briefly the aëronautical meet at Rheims and tabulated the more important records that were there set up. But such records are being made and bettered so rapidly that it is difficult to appreciate what they really mean, unless one keeps them all in mind. To this end I present herewith a summary of important aëroplane flights, or records, arranged under several headings to bring out important points.

It is useless to speculate as to what the future holds for us, yet it is difficult to refrain from imagining a day, not far distant, when the regular carrying of passengers for long flights by aëroplanes will be so common as to fail to attract even passing notice.

Flights Exceeding One Hour in Duration

Table 1 lists 40 flights, every one of which exceeds one hour in duration. The first in point of date is the flight of 1 hour 2 minutes 15 seconds made by Orville Wright at Fort Meyer, Va., on September 9, 1908. Thus the 40 flights of this table all took place in a period of less than one calendar year. Truly, a marvelous development!

The longest flight, 3 hours and 15 minutes in duration and 118 miles in distance, is as long in time as maximum express train runs on our railroads, and from two to three times longer in miles than average express train runs between station stops.

In mechanism that goes through an extended process of development and improvement a point is frequently reached where the machine begins to outstrip the operator, either in speed or in the tax upon physical endurance. That point is apparently in sight in aëroplane development reading from the records now before us.

The Men Who Made the Records

Table 2 gives the names of 25 men who have made sustained flights. The fact that there are 25 names there set down, that 25 men have made from one each to many sustained flights, is the index finger on the sign-board of progress pointing onward to the time when many of the human family will fly. "What man has done man can do."

In nationality most of these men are sons of fair France, sons of whom their mother country can be proud indeed. Of the others, four are our countrymen, Wilbur Wright, Orville Wright, Curtiss and Willard. One is an Italian and one an Englishman.

Of the machines used all were either French or American made.

Flights with One Passenger

Five flights are worthy of note in each of which a passenger was carried: Orville Wright carrying Lieutenant Lahm for 1 h. 12 m. 40 s.; Wilbur Wright with

*Secretary, Aero Club of America.

Aviator.	Performance in Time.		Machine.	Motor.
	h. m. s.			
1. Farman	3 15	unofficial		
	3 4 56⅘	official		
2. Paulhan	2 43 24⅘			
3. Sommer	2 27 15			
4. W. Wright	2 20 23⅘			
5. Latham	2 18 09⅘			
6. Bunau-Varilla	2 10 13⅘			
7. Count de Lambert	1 57			
8. Tissandier	1 48			
9. Rougier	1 22 16			
10. O. Wright	1 20 45			
11. Curtiss	52 30		Curtiss	Curtiss
12. Bleriot	50 8		Bleriot	Auzani
13. Delagrange	50		Bleriot XI.	Auzani
14. Fournier	41		Voisin	Itala
15. Lieut. Calderara	40		Wright	Wright
16. Gobron	36		Voisin	Gobron
17. Lefebvre	35		Wright	Wright
18. Legagneux	23		Voisin	Gobron
19. Demanest	20		Antoinette VI.	Antoinette
20. Willard	19 30		Curtiss	Curtiss
21. Cockburn	18		Farman	Gnome
22. de Caters	17		Voisin	Antoinette
23. de Rue (Captain Ferber)	16		Voisin	Antoinette
24. Ruchonnet	16		Antoinette	Antoinette
25. Guffroy	11		R. E. P.	R. E. P.

TABLE 2. BEST PERFORMANCES OF LEADING AVIATORS IN SUSTAINED FLIGHTS.

Duration of Flight.			Aviator.	Date.	Place.	Machine.	Type.	Engine.
h.	m.	s.						
3	15		Henri Farman	August 27, 1909	Betheny Plains, near Rheims	Farman	Biplane	Gnome
3	04	56⅘	Henri Farman, official	August 27, 1909	Betheny Plains, near Rheims	Farman	Biplane	Gnome
2	43	24⅘	Louis Paulhan	August 25, 1909		Voisin	Biplane	Gnome
2	27	15	Roger Sommer	August 7, 1909	Champ de Chalons, France	Farman	Biplane	Vivinus
2	20	23⅘	Wilbur Wright	December 31, 1908	Le Mans, France	Wright	Biplane	Wright
2	18	9⅘	Hubert Latham	August 26, 1909	Betheny Plains, near Rheims	Antoinette	Monoplane No. VII.	Antoinette.
2	10	13⅘	Etienne Bunau-Varilla	August 29, 1909	Betheny Plains, near Rheims	Voisin	Biplane	E. N. V.
2	10		Roger Sommer	August 4, 1909	Champ de Chalons, France	Farman	Biplane	Vivinus
1	57		Count de Lambert	August 26, 1909	Betheny Plains, near Rheims	Wright	Biplane	Wright
1	54	53⅘	Wilbur Wright	December 18, 1908	Le Mans, France	Wright	Biplane	Wright
1	52	40	Wilbur Wright	December 30, 1908	Le Mans, France	Wright	Biplane	Wright
1	50	30	Roger Sommer	August 1, 1909	Champ de Chalons, France	Farman	Biplane	Vivinus
1	48		Paul Tissandier	August 27, 1909	Betheny Plains, near Rheims	Wright	Biplane	Wright
1	40		Hubert Latham	August 27, 1909	Betheny Plains, near Rheims	Antoinette IV.	Monoplane No. VII.	Antoinette
1	32	45	Louis Paulhan	August 7, 1909	Malo-les-Bains, near Dunkirk, France	Voisin	Biplane	Gnome
1	31	25⅘	Wilbur Wright	September 21, 1908	Le Mans, France	Wright	Biplane	Wright
1	23	39⅘	Paul Tissandier	July 23, 1909	Abrest Aerodrome, near Vichy, France	Wright	Biplane	Wright
1	23	30	Roger Sommer	July 27, 1909	Champ de Chalons, France	Voisin	Biplane	Renault
1	23		Henri Farman	July 19, 1909	Champ de Chalons, France	Farman	Biplane	Vivinus
1	22	16	Rougier	August 29, 1909	Betheny Plains, near Rheims	Farman	Biplane	Vivinus
1	21	58⅘	Louis Paulhan	August 23, 1909	Abrest Aerodrome, near Vichy, France	Voisin	Biplane	Gnome
1	20	45	Orville Wright	August 20, 1909	Ft. Meyr, Va., U. S. A.	Wright	Biplane	Wright
1	14	20	Orville Wright	September 12, 1908	Ft. Myer, Va., U. S. A.	Wright	Biplane	Wright
1	12	40	Orville Wright	July 27, 1909	Ft. Myer, Va., U. S. A.	Wright	Biplane	Wright
1	10	24	Orville Wright	September 11, 1908	Ft. Myer, Va., U. S. A.	Wright	Biplane	Wright
1	10		Louis Paulhan	August 23, 1909	Betheny Plains, near Rheims	Voisin	Biplane	Gnome
1	9	45⅘	Wilbur Wright	October 10, 1908	Le Mans, France	Wright	Biplane	Wright
1	7	37	Hubert Latham	June 5, 1909	Champ de Chalons, France	Antoinette IV.	Monoplane No. VII.	Antoinette
1	7	24⅘	Wilbur Wright	September 28, 1908	Le Mans, France	Wright	Biplane	Wright
1	7	19	Louis Paulhan	July 15, 1909	Le Bray Ella Aerodrome, near Douai	Voisin	Biplane	Gnome
1	5	52	Orville Wright	September 10, 1908	Ft. Myer, Va., U. S. A.	Wright	Biplane	Wright
1	5	30	Roger Sommer	July 22, 1909	Champ de Chalons, France	Farman	Biplane	Vivinus
1	5		Roger Sommer	August 27, 1909	Betheny Plains, near Rheims	Farman	Biplane	Vivinus
1	4	26⅘	Wilbur Wright	October 6, 1908	Le Mans, France	Wright	Biplane	Wright
1	4		Roger Sommer	July 18, 1909	Champ de Chalons, France	Farman	Biplane	Vivinus
1	3		Louis Paulhan	August 23, 1909	Betheny Plains, near Rheims	Voisin	Biplane	Gnome
1	2	15	Orville Wright	September 9, 1908	Ft. Myer, Va., U. S. A.	Wright	Biplane	Wright
1	2	13	Paul Tissandier	May 20, 1909	Pont-Long, near Pau, France	Wright	Biplane	Wright
1	1	51⅘	Hubert Latham	August 26, 1909	Bethany Plains, near Rheims	Antoinette IV.	Monoplane No. VII.	Antoinette
1	0	30	Roger Sommer	August 15, 1909	Champ de Chalons, France	Farman	Biplane	Vivinus

TABLE 1. AEROPLANE FLIGHTS EXCEEDING ONE HOUR IN DURATION AND MADE PRIOR TO AUGUST 29, 1909.

M. Poinlére for 1 h. 9 m. 45⅖ s.; Wilbur Wright with Mr. Fordyce for 1 h. 4 m. 26⅕ s.; Wilbur Wright with M. F. Reichel for 55 m. 37⅖ s., and Lieutenant Calderara with Lieutenant Savoia for 40 minutes.

FLIGHTS WITH TWO PASSENGERS

The longest flight with two passengers is to the credit of Farman, time 10 minutes, 39⅖ seconds. Gobron and Blériot have also taken two passengers in short flights.

Let us again stop a moment to realize that all of these achievements have taken place during less than one year. Surely, a wonderful year in the annals of machine building!

I am indebted to George F. Campbell Wood for the tabular arrangement of much of this material.

It's So Easy to Adopt the Metric System

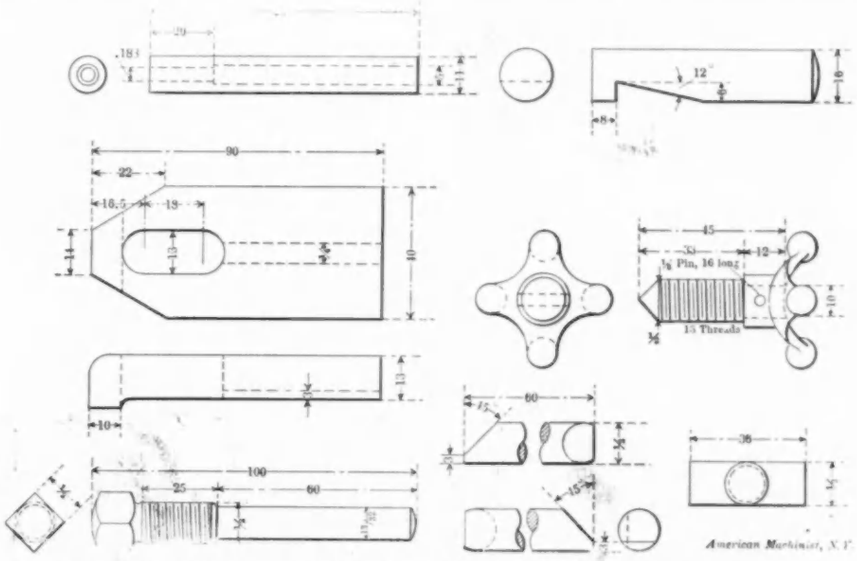
We are constantly being reminded, principally by those who know very little of machine-shop work, of the ease with which the metric system can be adopted in any shop if we will only overcome a few ingrowing prejudices and approach the question with an open mind. The details shown in the accompanying illustrations are a small portion of a blueprint of a new device recently made by a large shop which is building a French product and which "adopted" the metric system several years ago. Their product is, or rather was, made from French drawings, so that it is easier for them to use metric measurements as much as possible on this account, but a little study of the dimensions on the details given will show a delightful mixture of metric and English measurements that must be extremely pleasing to the ardent advocate of its compulsory adoption.

Beginning in the upper left-hand corner, we find a plain tool-steel spindle 83 millimeters long, 11 millimeters outside and 5 millimeters inside diameter, for about three-fourths of its length. At the left, however, we find the exceedingly vulgar English dimension of 0.188 inch internal diameter, but the day is saved by making this part 20 millimeters long.

Below this is a very simple strap in which millimeters hold forth in all their glory with the exception of the slot planed on the underside, which is ¼ of an inch wide and 3 millimeters deep.

At the bottom is a machine stud or screw, 100 millimeters long, 60 millimeters of this being turned plain to the very awkward diameter of 13/32, and a ½-inch screw 13 threads to the inch, while the head of the stud is ½ inch square.

Beginning again in the right-hand column, we find the only piece that is entirely metric in dimensions, while below it is the extremely interesting combination of a handle and screw in which the lengths are given in millimeters in connection with a ½-inch, 13-inch pitch screw, turned 10 millimeters in diameter where it fits the handle and held in place by a pin ⅛ inch in diameter, but 16 millimeters long.



A RECENT EXAMPLE OF THE CONFUSION DUE TO ADOPTING THE METRIC SYSTEM

The sliding key with a tapered end, underneath the handle, is all millimeters except the diameter, which is ½ inch, while the common T-headed stud at the extreme right has a head 36 millimeters long and ½ inch wide.

These are not errors of either omission or commission, but are the necessary compromises in order to use these devices in connection with the commercial machine tools and appliances in use in this shop. The ½-inch width on the T-head bolt accommodates a standard slot on a milling or other machine, and a similar reason exists for every one of the apparent lapses from the straight and narrow paths of metric rectitude.

When we see the difficulty of adopting a new form of measurement in connection with the millions of dollars worth of machine tools and other fixtures which are in use in our shops, it requires considerable argument to convince us that the change can be easily made or that its cost has been greatly exaggerated.

Design of a Chuck Key

BY F. REUTER

I often notice when a three-jaw chuck is screwed too hard on the lathe spindle, the man who wishes to remove it, generally puts the key in place on the side of the chuck and knocks on it until he gets the chuck loose.

Over a year ago I saw a toolmaker removing a chuck in the way described, but this time the wrench broke and left the chuck still in position on the spindle. I picked up the pieces and noticed that it was designed as shown in Fig. 1. The pin *A* was parallel to the sides of the square *B*. The pin *A* had been horizontal, so when he knocked on it the strain came on the fiber *e f*. Starting from this, I designed the new one like Fig. 2 when this wrench is in the chuck and the pin *A* horizontal, the strain will be taken by the diagonal *g h*, the line *g h* being 1.414 times longer than the sides of the square *e f*. In this way we increase the strength of the wrench about 35 to 40 per cent.

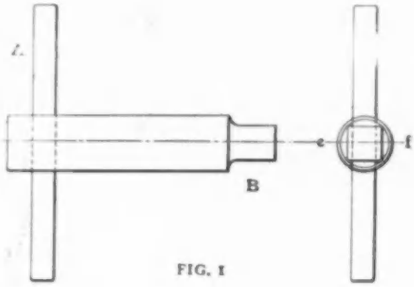


FIG. 1

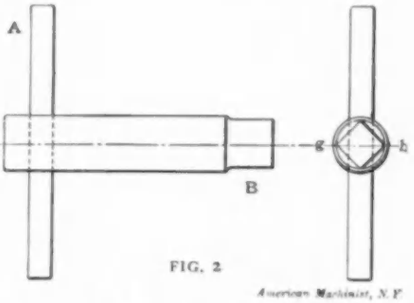


FIG. 2

DESIGN OF A CHUCK KEY

[If we caught a "toolmaker" or anyone except a cut apprentice removing a chuck in this way he would probably remember it for some time, this of course if we were in charge of the shop. A block of wood between the back of the bed and one of the jaws seems to us a better way to shift a stubborn chuck. ED.]

Six Alsatian Machine Tools of Recent Design

Motor-driven Machines with Many New Features Exhibited at Nancy, France, by the Societe Alsacienne de Constructions Mecaniques

SPECIAL CORRESPONDENCE

At a recent exhibition at Nancy, France, the Société Alsacienne de Constructions Mécanique of Grafenstaden, Alsace, exhibited among other things six machine tools of recent design which are of interest as showing the trend of design among progressive French machine-tool builders.

A 24-INCH ENGINE LATHE

This lathe is shown in Figs. 1 and 2,

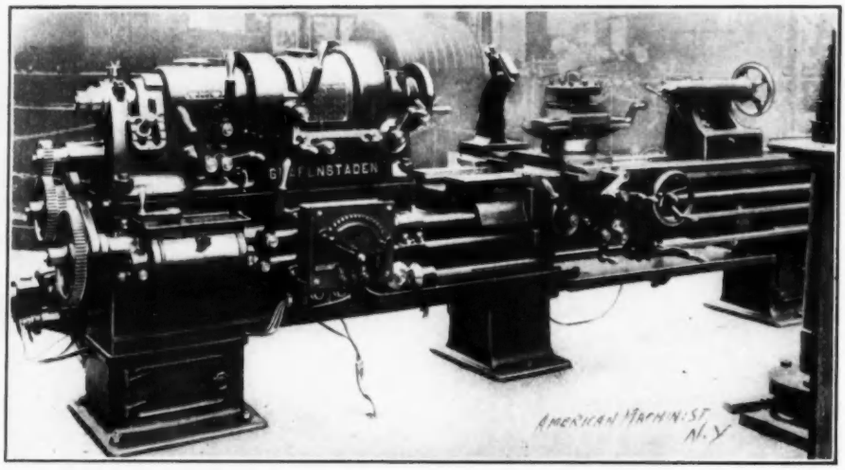


FIG. 1. FRONT OF 24-INCH ALSATIAN LATHE

where it is seen provided with an electric motor for individual drive. However, if desired, it can be provided with a constant-speed pulley instead. It has a swing of 300 millimeters (12 inches) and a length between centers of 3000 millimeters (10 feet). The bed is of a box section with flat ways and is supported by four box-section legs of ample proportions having a complete system of pans and gutters for catching lubricants. The heavy geared headstock is provided with a hollow spindlle of special alloy steel running in bronze boxes.

The carriage is provided with double of 300 millimeters (12 inches) and a driving mechanism. It is provided with a tool block in the shape of a square turret which can be swiveled to any angle and is arranged to hold four tools; also a steady rest, as shown in the illustration. The tailstock is arranged with a transverse adjustment to be used in turning tapers.

The drive is either directly by belt or pulleys, or through double or quadruple trains of gears from a constant-speed electric motor. This arrangement provides 13 speeds, the highest of which is without the use of the gears. An operating lever on the front of the machine throws a clutch into or out of engagement, and thus starts or stops the machine without changing condition of the motor.

By means of two operating levers on the front of the machine six feeds are obtained in both longitudinal and transverse directions. Threading is done by the lead screw, the reversal for which is obtained through a feed-changing mechanism of spur gears and cone frictions located on the headstock and operated by a single lever.

A soda-water pump is provided and the interior of one of the legs forms a reservoir to which the cutting compound is returned and from which it is pumped.

The speeds of the faceplate in revolutions per minute are as follows: 6.3, 8.8, 12.7, 17.5, 25.5, 35.1, 51, 70.3, 102, 140, 204, 281 and 400. The longitudinal feeds of the carriage in millimeters per revolution of the spindle are: 0.25, 0.39, 0.64, 1.01, 1.59, 2.58 (ranging from approximately 0.01 to 1.03 inches). The cross-feeds in millimeters per revolution of the spindle are: 0.12, 0.2, 0.32, 0.5, 0.79, 1.29 (about 0.05 to 0.52 inch). The maximum metal-removing capacity of the lathe is given as 300 cubic centimeters per minute (about 18 cubic inches).

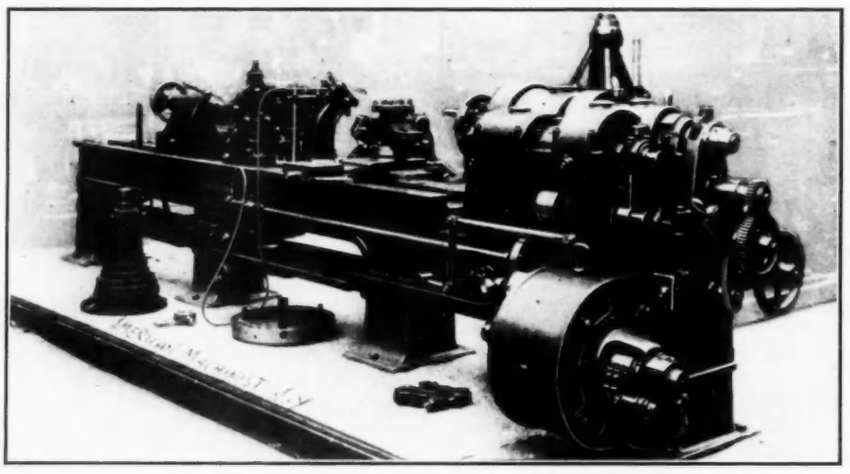


FIG. 2. REAR OF 24-INCH ALSATIAN LATHE

A 33-INCH VERTICAL LATHE

Fig. 3 illustrates a small vertical lathe having a table diameter of 660 millimeters (about 26 inches) and a capacity in the maximum diameter that can be turned of 825 millimeters (about 33 inches). The maximum hight that can be turned is 335 millimeters (about 13½ inches); the maximum length of feed of the turret is 315 millimeters (about 12½ inches).

The frame and upright are formed from a single casting. The table is heavy and sits into a V-shaped annular guide so arranged as to automatically take up wear. At the center of the table is a bearing for boring bars and the like. The saddle is of substantial design, is counterbalanced, may be inclined to an angle of 45 degrees either side of the vertical and its movements are either under hand or power control.

Its turret is arranged to carry four tools. The drive for the table is through bevel gears and either a double or quadruple train of change gears from a variable-speed motor. Thus there are two series of speeds and the variation of either

entire series may be obtained while the machine is running by a rheostat that controls the motor. The power feed is belt-driven through three-step cones.

The revolutions per minute of the table are as follows: 3.4, 4.9, 7.1, 10.3, 15, 21.6, 31.4 and 45. The vertical feeds per revolution of the table in millimeters are as follows: 0.182, 0.5, 1.36 (ranging approximately from 0.007 to 0.544 inch). The horizontal feeds per revolution of the table in millimeters are 0.21, 0.565, 1.54 (ranging approximately from 0.008 to 0.062 inch).

A 60-inch Vertical Lathe

Another, so termed, vertical lathe larger than the one just described is shown by Figs. 4 and 5. An interesting feature of design is in the use of two tables, a large one as seen in Fig. 4 and a smaller one as seen in Fig. 5. In connection with the smaller table a heavy ring or cover is placed over the unused part of the large table in order to prevent it from injury. The method of holding and supporting this cover by means of studs in the base of the machine can be plainly seen. The large table is 1400 millimeters (about 56 inches) and the maximum diameter that can be turned upon it is 1500 millimeters (60 inches). The diameter of the smaller table is 825 millimeters (33 inches) and the maximum diameter that can be turned upon it is 700 millimeters (28 inches). In regard to vertical hight that can be turned,

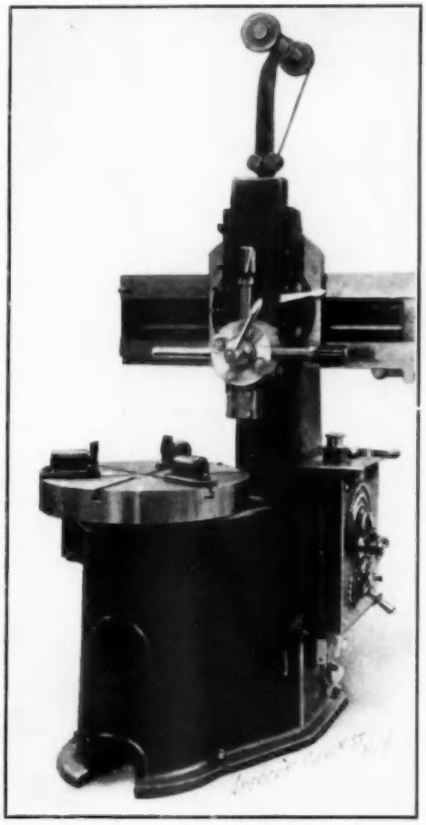


FIG. 3. AN ALSATIAN VERTICAL LATHE

the maximum on the large table is 840 millimeters (33½ inches) and similarly on the smaller table 735 millimeters (29½ inches).

The bed and column are a single casting with a suitable extension at the rear for the driving motor and gearing. The large table is guided by an annular V-shaped guide which automatically takes up the wear. The use of the small and large tables we have touched upon, yet another point in connection with the use of the cover plate around the small table is worthy of consideration, namely it serves as a safety device to prevent injury to the workmen.

The rail is of usual construction and carries two saddles, the one having a four-holed turret and the other a sliding bar. This bar can be swiveled to an angle of 45 degrees either side of the vertical. The table is driven through bevel gears and a chain of double or quadruple spur gears from the variable-speed motor. The combinations of these gears gives four series of speeds for the work. The intermediate steps in each series are, of course, obtained by using the rheostat of the motor.

Each saddle has an independent automatic feed, belt-driven through four-step cones. These feeds are all controlled by means of adjustable stops.

The table speeds in turns per minute are as follows: 1.58, 3.6, 4.6, 9.2, 11.5, 23, 29 and 58. The horizontal feeds in millimeters per revolution of the table are: 0.20, 0.6, 1.16, 2.44 (from 0.011 to 0.976 inch). The vertical feeds in millimeters

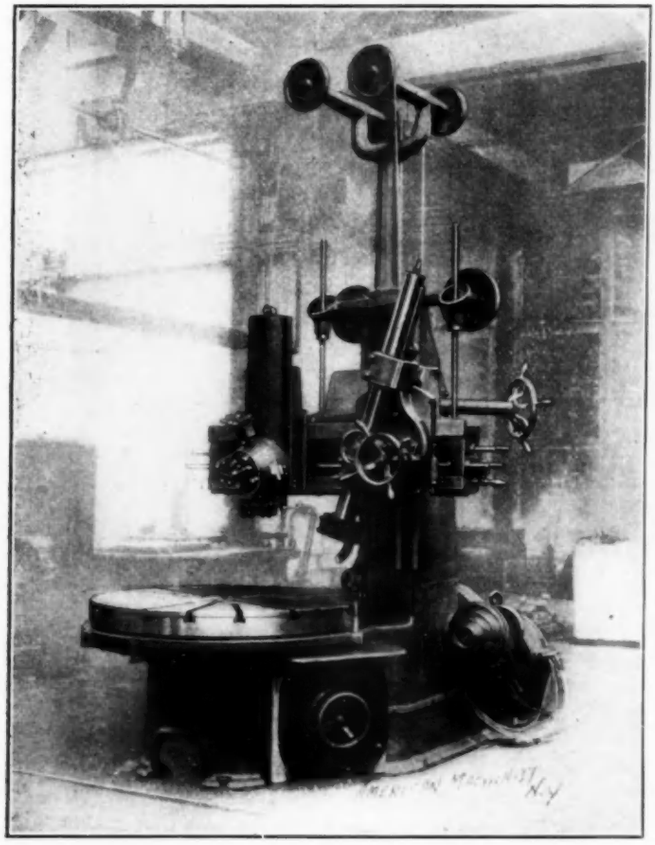


FIG. 4. AN ALSATIAN 60-INCH VERTICAL LATHE

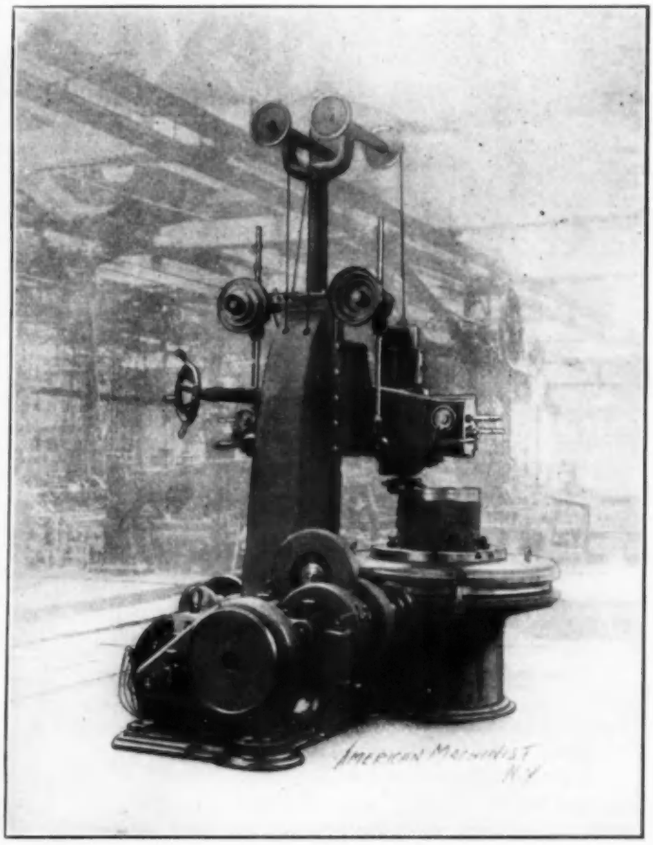


FIG. 5. REAR VIEW

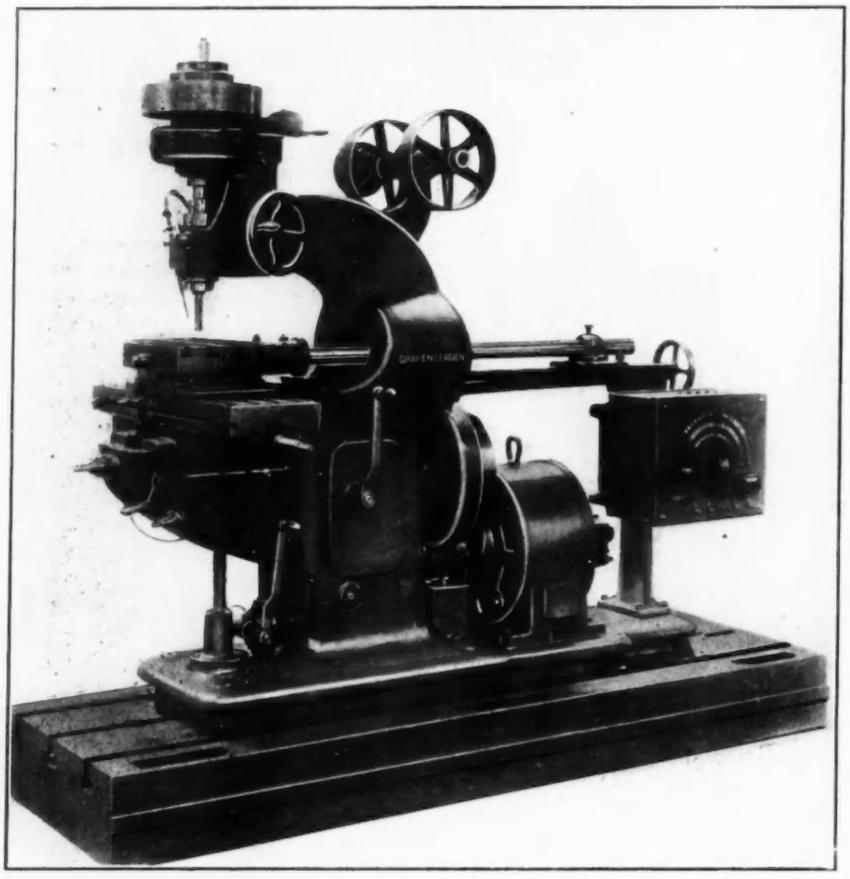


FIG. 6. AN ALSATIAN VERTICAL MILLER WITH RADIUS ATTACHMENT

per revolution of the table are: 0.3, 0.62, 1.2, 2.52 (from 0.012 to 0.101 inch).

Vertical Miller for Radius Milling

A vertical milling machine of unusual design is shown in Fig. 6, the striking feature being the large opening through the pillar for the operation of a radius milling attachment. The base of the machine is extended rearward to carry the driving motor, its rheostat and a support for the adjustable fulcrum of the attachment for milling curves.

In capacity the table has a traverse of 780 millimeters (31 inches), a cross movement of 230 millimeters (9 inches), a vertical length of feed for the spindle of 120 millimeters (4¾ inches) and a maximum free hight between the top of the table and the spindle of 500 millimeters (20 inches).

Referring to details of construction, the spindle is of special alloyed steel running in bronze boxes arranged to take up wear. The knee is of heavy construction of a parabolic form. The device for radius milling consists of a small auxiliary table arranged to clamp to the main table and provided with a long bar reaching through an opening in the column to a fulcruming bracket at the rear. This fulcruming bracket consists of a rectangular plate sliding in a fixed drive. By setting this fulcruming bracket to any position desired, a curve can be milled, whose radius is equal to the distance from the cutter to the fulcruming point. The arrangement of this auxiliary table with its oscillating support is plainly shown in the illustration.

The drive is from a variable-speed motor by a endless belt over idler pulleys in the usual manner. A train of gears is in the head whereby two series of speeds of the cutter spindle can be obtained. The intermediate steps in each series are, of course, controlled by the rheostat. The speeds of the cutter spindle per minute with the direct drive range from 133.3 to 400; with the back gears from 36.8 to 110.5. The feeds in millimeters per revolution of the spindle are: 0.06, 0.12, 0.2, 0.3, 0.52, 0.91 (from 0.002 to 0.036 inch) and 0.24, 0.43, 0.72, 0.108, 1.92, 3.26 (from 0.01 to 0.129 inch).

The metal-removing capacity of the machine is 70 cubic centimeters per minute (approximately 4.2 cubic inches).

A 16-inch Stroke Slotter

The capacity of this machine which is illustrated in Fig. 7, is shown by the following dimensions: The longitudinal movement of the table is 700 millimeters (28 inches); transverse movement, 275 millimeters (11 inches). The free hight above the table is 300 millimeters (12 inches).

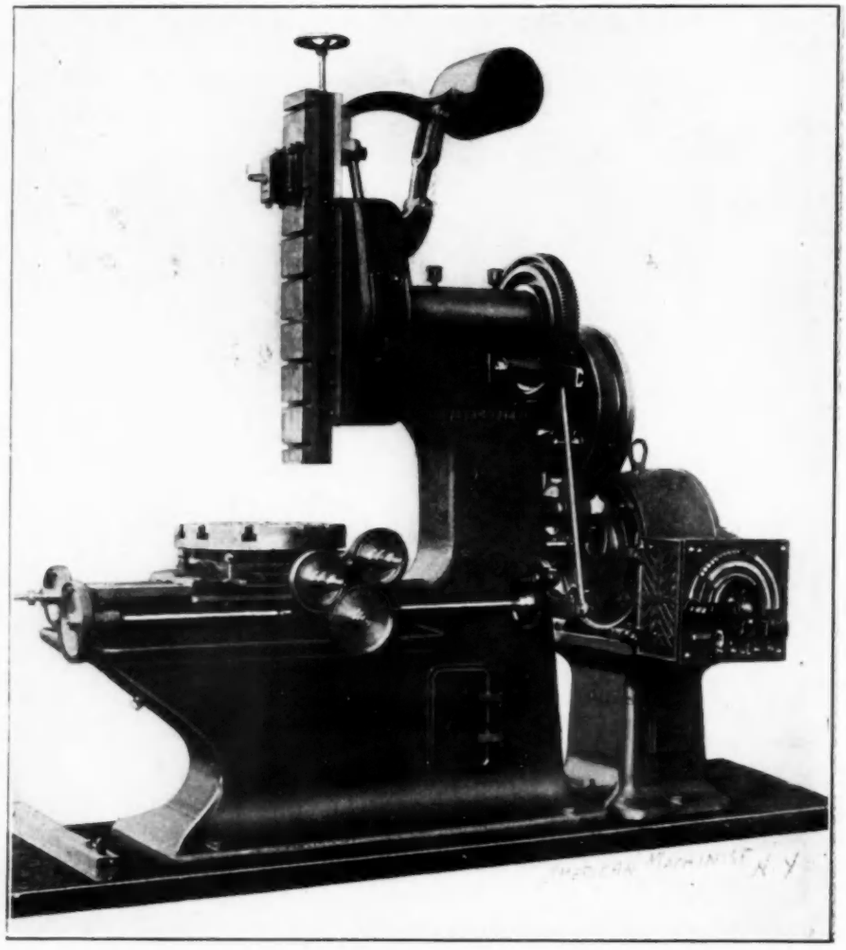


FIG. 7. AN ALSATIAN SLOTTER

The features of design and construction which are worthy of consideration are the variable-speed motor for direct driving mounted on a separate pedestal at the back, the ram provided with a series of crossed T-slots, so arranged that the tool block can be set in any position desired, special tool blocks so arranged that they can be set in various positions and used to machine work on the side; an automatic adjustable feed and an ample pan cast integral with the base and entirely surrounding the working area to receive lubricant. It should be noted that pieces of work exceeding the free hight between the table and overhang of the pillar can be machined from the fact that the tool block can be placed at any hight desired on the ram.

The number of strokes of the ram vary from 19 to 57. The feeds of the carriage vary from 0.23 to 1.63 millimeters (0.009 to 0.065 inch). The metal-removing capacity of the machine per minute is 40 cubic millimeters (approximately 2.4 cubic inches).

A Planer with Variable-speed Drive

The last machine to be shown is a large metal planer (see Figs. 8 and 9). The features of especial interest are the adjustable housing on the left-hand side of the machine and the variable-speed drive. This housing slides on ways on an extension of the bed; is moved by an adjusting screw operated by a hand ratchet, and can be set in any position desired throughout the limit of its travel. The cross-rail is of sufficient length to meet all of these adjustments. In place of the arch between the uprights, so well known in American machine-tool design, a heavy cylindrical shaft is used running through suitable clamping guides, one in each housing. These details are especially well shown in Fig. 9.

The variable-speed drive is from a motor situated at the back of the machine. Power is delivered to the machine itself by a single belt passing around a system of idlers, as seen in Fig. 9. The mechanism for reversal is situated within the bed and, unfortunately, is not properly shown by any of the illustrations. The general features of the design need no comment, as they are shown by Fig. 8. The ratio of the reverse to the cutting speed is 6 to 1.

The horizontal feeds range from 21.1 to 0.26 millimeters (0.844 to 0.01 inch). The feeds for the vertical saddle on the right-hand housing range from 4.4 to 0.33 millimeters (0.17 to 0.013 inch). The maximum metal-removing capacity of the machine is 600 cubic centimeters per minute (36 cubic inches).

Echoes from the Oil Country—Mechanics Being Made

By W. Osborne

Henry was put to work in the shop because his father worked there and was a good man. Mechanically the father was not anything extra, but he was a man to be depended on, sober, honest, careful and willing. Besides all of these good qualities he had shown a disposition to stay, and so had learned how much of the work ought to be done, and from doing it he was able to hold his own with men who were in reality much better mechanics than he was. There was one other thing about him that a foreman in a jobbing shop always appreciates, and that was that he was willing to tackle any job that came along. It did not make any difference if the job was coarse or dirty or had to be done after regular hours. His starting point in the shop had been as fireman and general shop helper. Besides looking after the boiler and engine he had about as many duties as the comic writers sometimes enlarge on. When he had any spare time on his hands he was supposed to do anything that he could do and so in the course of time it came about that he was doing the work and getting the pay of a machinist. The crawling-up process had been slow, and had been done without any arrangements having been made about learning the trade. The opportunity had been there for him to find his place according to his natural ability and disposition, and he had found it without any direct striving for it. He had simply tried to do his best with the jobs that came to hand and in the endeavor he had grown.

So much for the father and the way he had done.

After the boy got a job in the shop he gradually began to find his place according to his natural gifts. At first his work was running errands and sweeping the floor, and once in a while some small job was given to him, generally to clean up for the man who was to do it. It soon began to be known that in some ways Henry was a remarkably good boy to have around.

After he had been there long enough to have learned the names and appearance of things he seemed to be able to keep track of where everything was without effort. If anything could not be found Henry was called.

"Hey, Hen.! Where is that old piece that we made a new one in place of, for that old farmer with the Horace Greeley whiskers? It was a piece like this." A lightning sketch is made on the floor with a piece of chalk.

"He took away the new piece and left the old one and now he has sent in after it." Henry looks at the sketch, and at the man.

"Was it a piece that you was working on while the man waited, and you was

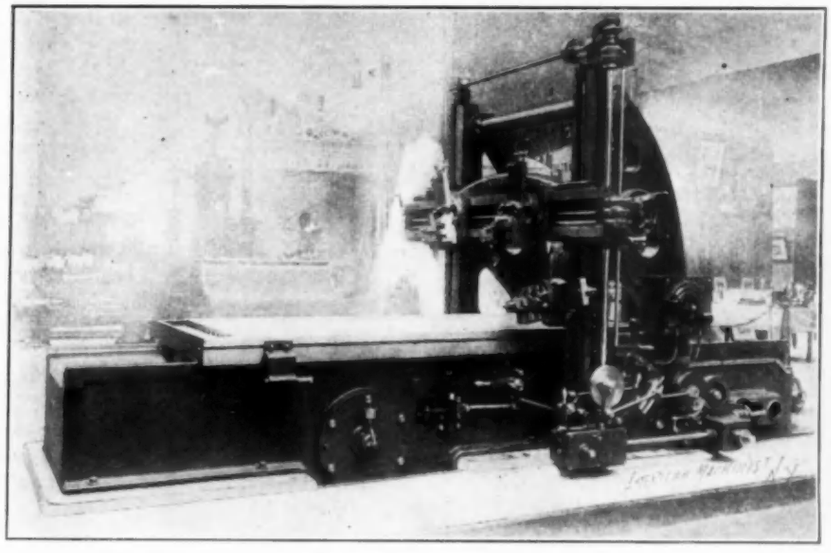


FIG. 8. AN ALSATIAN PLANER

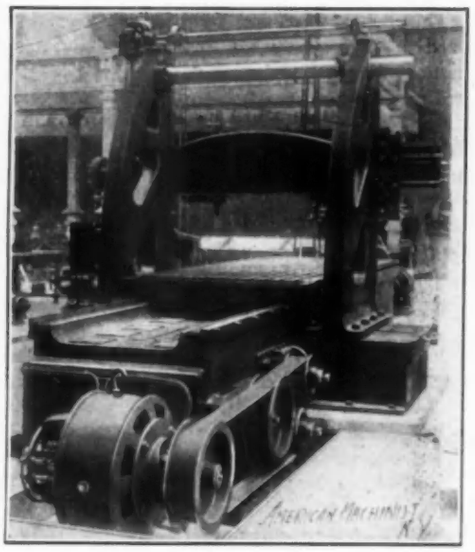


FIG. 9. REAR VIEW

working over there?" he asks. That was the piece and the place and Henry drags forth the piece wanted.

"Henry, bring me four ¾x4-inch bolts and a ⅝x1½-inch set screw for this job."

"There isn't any ¾x4-inch bolts in the shop. There are some 4¼- and a lot of 3½-inch ones."

"I guess you are off your nut. Go and look."

"There hain't no use of going and looking. The last 4-inch bolts were used on that wax-press job."

"Go on, what are you talking about? There was a big bin full of those bolts and only about a dozen has been used."

"There was fifty of them, and over half of them was used on the first job and Dick took three out into the country, and Sam used eight on the boiler-front job, and the rest of them were used on that wax-press job. There is one under the lathe there, and it is bent."

The man investigates and finally uses the 4¼-inch bolts, and has more respect for information received from Henry after that.

It got to be the regular thing to go to Henry when things were not in their regular places.

This being a jobbing shop it was very hard to know just what to keep on hand in the way of supplies, but the foreman had made out a list of sizes of bolts, nuts, set and cap screws, pipe fittings, etc., that he had found it best to always have on hand, and with this list he would run over the stock. At such times he would use Henry to help him, and it soon got to be that if he read the list off that Henry could tell him how the stock stood. At the most it only took a glance into the bin to do it.

You will understand that this shop did not have a stock room. There were a lot of bins filled with bolts. The bins were of all sizes and so were the bolts, and there was not any method in the arranging of either bins or bolts. Big bolts in little bins and little bolts in big bins. If a new size of bolt was wanted and gotten it went into the empty bin that was big enough to hold it, and if one bin would not hold the supply it might be put in two or more and they might not be together, or part of them might be left in the keg or barrel.

Over yonder were a lot of bins where pipe fittings were kept. The nipples were kept on shelves in another place. Under the stairs were a lot of kegs that held nuts and washers, and so it went. Stock was put in the places that were not used for other purposes. These places were not always convenient places and the shop was growing along toward having a stock room, but didn't know it, and if Henry grew in the right direction he was apt to grow into a stock clerk.

While Henry was good at some things there were other things that he was not good at. The foreman used to try him at machine work. On some of it he did very well and on some of it he was the poorest of any boy who had ever been in the shop. After repeated trials the foreman found that it was not safe to put Henry on any job that required judgment of a mechanical nature. He was very good at anything that required memory, but very poor when it came to exercising that mechanical faculty that seems to be a reasoning back and forth from cause to effect and from effect to cause.

It had taken a number of costly "accidents" to demonstrate this to the satisfaction of the foreman, but the result had been that Henry did not progress very fast as a mechanic.

One day Henry came to the foreman with a proposition. It was that he be allowed to take a vacation of a couple of weeks with the privilege of getting a job elsewhere if he could. If he got the job and got along he would send word and would not come back. If he could not hold the job he was to be allowed to come back again. The foreman told him to go and wished him "good luck" in the venture. In a couple of weeks he was back again, and the foreman asked for an account of his experiences.

"I had several jobs. At the first one I hadn't been at work very long before the foreman asked me where I had learned the trade, and I told I had learned it here." The foreman groaned inwardly. "And he asked me if I had a union card about me to prove it, and when I said I hadn't he wouldn't let me work any longer. Fellows told me afterward that *they* did not have to belong to the union to work there. Then I got a night job. I got a letter from the superintendent and he said that he would pay me thirty cents an hour, and had all the work that they could do; but for all of that he laid me off after I had worked there three nights. He said that he didn't have any work to keep me going. After that I asked for a job on a milling machine, and somehow or other something happened and a lot of the teeth got broken out of the cutter, and I was afraid that they would blame it on me so I just came away, and then my uncle told me that the best thing that I could do was to come back."

"When you asked for these jobs you told them that you were a machinist, did you?" Henry nodded in the affirmative.

"Why did you call yourself a machinist?"

"Because I am a machinist. I have worked here for more than three years. I know that I have not worked on all of the machines, but you have told all of us boys many and many a time that if a boy understands the principles of work he does not have to do everything to be a machinist. Besides that I have taken a course in shop practice, and I got 100 in almost everything. I passed better than any boy that I know of that took the course. Lots of fellows that call themselves machinists couldn't get through at all, but gave the course up."

The foreman knew this last statement to be true. He knew of boys, and men too, who had started in on some of these correspondence courses and never made any progress worth mentioning, but he also knew that some of the worst students of the lot were valuable men when it came to getting out work in the shop.

When it is known how strong the effort is to sell courses by those who are financially benefited by the sales it is not much to be wondered at that all are not benefited who buy them. Henry is not the only one who placed too much value on the information received in such a way.

A bright young man who was a very good workman was running a mill. He was getting the top machinist's wages and was one of the steady men. One day he quit and the foreman learned that he had gotten a job in another shop as a "tool maker" and was working in the "tool room." He also learned that this young man had taken a course in "tool making" from one of the "schools." The shop which he had quit did not have a tool room or a tool maker. When they had to have a tool made one of the ordinary machinists made it right out in the shop.

One day the foreman met the young man. "Hello, Dick! How are the tool-making job and you getting along together?"

"I'm not working there. I am over at the big shop. Tool making is not what it is cracked up to be. You are cooped up in a little hole where you are just boring and turning and threading just like you always did, only you get your sizes from a drawing instead of doing the same piece over and over, and you never get any chance to do those nice little stunts that the books showed you, and anyhow the fellow in the drawing room figures out what is wanted and he doesn't want anyone to butt in on him either. Oh, yes, I was green all right, all right, but I got my eye teeth cut. I only lasted three weeks there. Then I quit, and was ashamed to ask for a job so soon after making such a break."

And Dick was a full-fledged machinist, and a man who had attained to the years of discretion and to the dignity of being the head of a family.

A perusal of the Journal of the United States artillery shows that a modern fighting man in the artillery service must be posted on electricity, mechanics and mathematics. Even the enlisted men have something to do with the mechanics of the case and the schools at Fort Totten and other places afford a good chance for practical education along these lines. The gunners receive practical instruction in range finding which means surveying-instrument work with its refinements and other studies which make it a mistake to look on them as uneducated men.

Factors for Proportioning Spur Gears

Complete Formulas and Constants for Proportioning Solid and Split Spur Gears and for Estimating Weights. Based on Modern Practice

BY CHARLES H. LOGUE

The formulas contained in this paper should not be used indiscriminately, as one design will not meet all conditions. No attempt has been made to proportion arms or rim to the power to be transmitted, as all proportions are derived from the pitch and face of the gear, with the double object of obtaining equal strength and sound castings.

As the smallest section of a casting is, per square inch, its strongest part, this fact should enter more into the question of proportion than has been the custom in the matter of gears. To illustrate the value of this, a test piece cut from the point of a cast gear tooth will often be as much as 30 per cent. stronger than a similar piece cut from its root. Hence the rim of a gear is made thinner than has been the practice, and the central rib deeper, to secure the necessary section and thus obtain a stronger casting with the same weight of material. This same rule applies to the hub, the outside diameter being reduced and a deeper rim added, and reinforcements placed over keyways, or, better still, two reinforcements directly opposite, especially if the gear is to be balanced; in fact, this is imperative even at relatively low velocities. For the same reason the teeth should be cored whenever it is possible to do so, as the rim of a casting for a cut gear has always the heaviest section, and, therefore, most subject to blow holes, especially at the junction of the arms and rim. It follows, then, if this be true, that the more uniform the section throughout the sounder and stronger the casting.

Cored teeth, however, should be machine spaced, as uneven spacing will render it difficult, if not impossible, to cut the teeth in the usual manner. To secure accurate spacing when cutting it is absolutely necessary that the cutter have an equal amount of stock to remove from each side of the tooth space. Also exposure to hard scale and core sand quickly destroy the cutter. When the teeth are to be planed this point is not of so much importance, as a little unevenness of stock can be readily taken care of, but the cut should be always under the scale if time is of any importance.

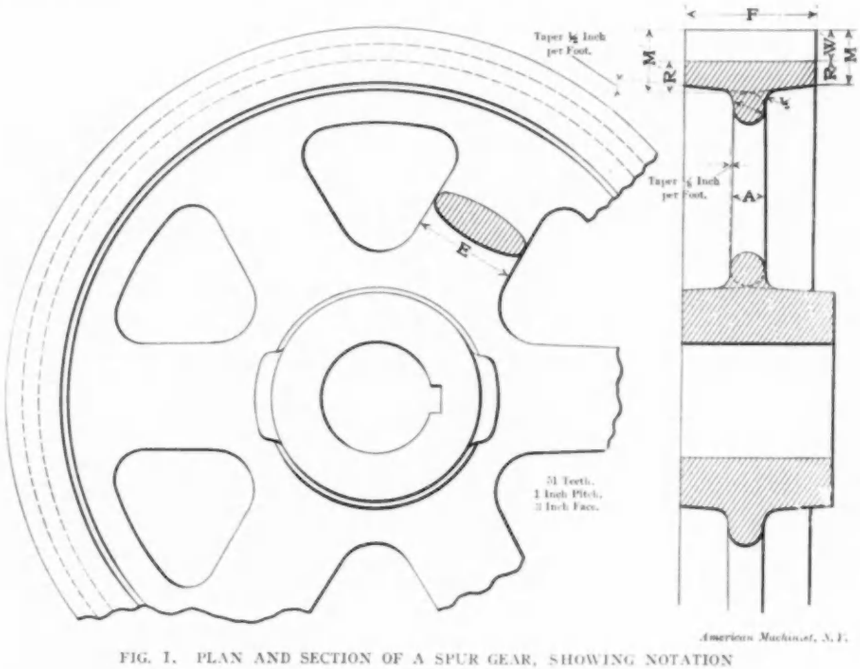


FIG. 1. PLAN AND SECTION OF A SPUR GEAR, SHOWING NOTATION

Formulas

These formulas are based on Browne & Sharpe standard 14½-degree involute tooth.

1. Thickness of Rim,

$$M = \frac{3.927}{p}, \text{ or } 1.25\,p'$$

2. Mean Thickness of Rim,

$$M' = \frac{5.026}{p}, \text{ or } 1.60\,p'$$

3. Mean Thickness of Rim under Tooth,

$$R' = \frac{2.868}{p}, \text{ or } 0.913\,p'$$

4. Whole Depth of Tooth,

$$W' = \frac{2.157}{p}, \text{ or } 0.6866\,p'$$

5. Minimum Thickness under Tooth,

$$R' = \frac{1.769}{p}, \text{ or } 0.563\,p'$$

6. Area of Rim Total,

$$MF' = M'F$$

7. Area of Rim under Tooth $= R'F$.

8. Average Area of Arm,

$$Æ = tF\ 1.3, \text{ or } MF\ 0.52$$

9. Average Thickness of Arm,

$$A = \sqrt{\frac{Æ\ 1.27}{3}}$$

10. Average Width of Arm,

$$E = 3\,A.$$

11. Outside Diameter of Hub $=$ Bore $+ \frac{3}{4}\sqrt{NF}$

12. Number of Arms $= 4, 6, 8, 10$, etc., according to design and diameter of gear. See detail of formulas.

p = Diametral pitch,
p' = Circular pitch,
t = Thickness of tooth at pitch line.

Discussion of Formulas

1. Thickness of Rim, M—The thickness of rim should be equal to 3.927 divided by the diametral pitch, or 1.25 multiplied by the circular pitch. When the gear is small and accurately made it is often good practice to make the dimension 1.12 of the circular pitch, and so secure the same section and additional strength by adding 50 per cent. to the depth of the central rib.

2. Mean Thickness of Rim, M'—By mean thickness is meant the thickness of one side of a parallelogram necessary to contain the actual area of the rim. This will take care of the central rib and fillets, so that by multiplying the width of the face of the gear by dimension M' the entire area of rim may be obtained. This will be found necessary, also for estimating the weight.

3. Mean Thickness of Rim under Tooth, R'—This dimension $\left(\frac{2.868}{p}\right)$ multiplied by the width of the face will give the area of the entire section of the rim and rib under the teeth.

4. Minimum Thickness of Rim under teeth, R—This determines the thickness of the rim under the tooth measured at the edge of the rim.

NOTE—If width of arm is desired, 2 or 2½ times the thickness instead of 3 times, as given, 2 or 2½ is to be substituted in formulas No. 9 and 10 instead of 3.

5. Whole depth of tooth, W'—This gives the whole depth of the tooth as per Brown & Sharpe standard $= 0.6866\ p'$; or $\frac{2.157}{p}$.

6. Total Area of Rim—The total area of the rim is found by multiplying the mean thickness M' by face of gear F.

7. Area of Rim under Tooth—The area of the rim under the tooth is determined by multiplying the mean thickness R' by the face F.

8. Average Area of Arm, $Æ$—The average area of the arm is that area midway between the inside of the rim and the outside of the hub, and is found by adding 30 per cent. to the area of the tooth at the pitch line, or the thickness of tooth at pitch line $t \times F \times 1.3$. The same result may be reached by taking 0.52 of $M' \times F$, although the foregoing is simpler. Taper of arm to be ⅛ inch per foot above and below this point.

9. Average Thickness of Arm A—The average thickness of arm may be determined by dividing the quotient of the area of arm $Æ \times 1.27$ by 3, and extracting the square root. If the arm was made in the form of a parallelogram it would not be necessary to multiply the area by 1.27; but as it is to be elliptical, this is essential to insure sufficient section, as 27 per cent. of the area of the parallelogram is lost when inscribing an ellipse therein.

10. Average Width of Arm E—To determine the width of an arm multiply its thickness by three.

11. Outside Diameter of Hub—As a rule the outside diameter of a gear hub is made double that of its bore, but when keyways are reinforced, or the gear is to carry a load less than proportional to the diameter of its shaft, the hub diameter may be less than this rule prescribes. Thus, if a gear of 30-inch pitch diameter was mounted on a shaft 15 inches in diameter the hub diameter should only be increased sufficiently to maintain its section and strength proportional to the gear, not to the shaft. Though formula 11 will proportion the hub to easily carry the entire load applied to the gear it should be used with discretion. Generally, however, when the bore is small or proportioned to the diameter of the gear, the

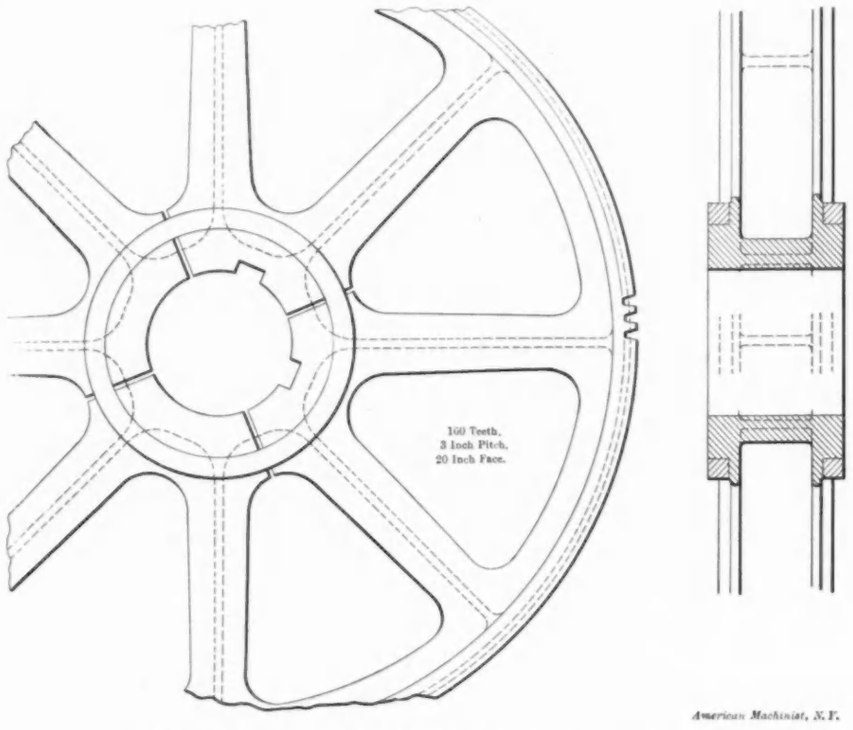


FIG. 2. PLAN AND SECTION OF SPUR GEAR WITH SPLIT HUB

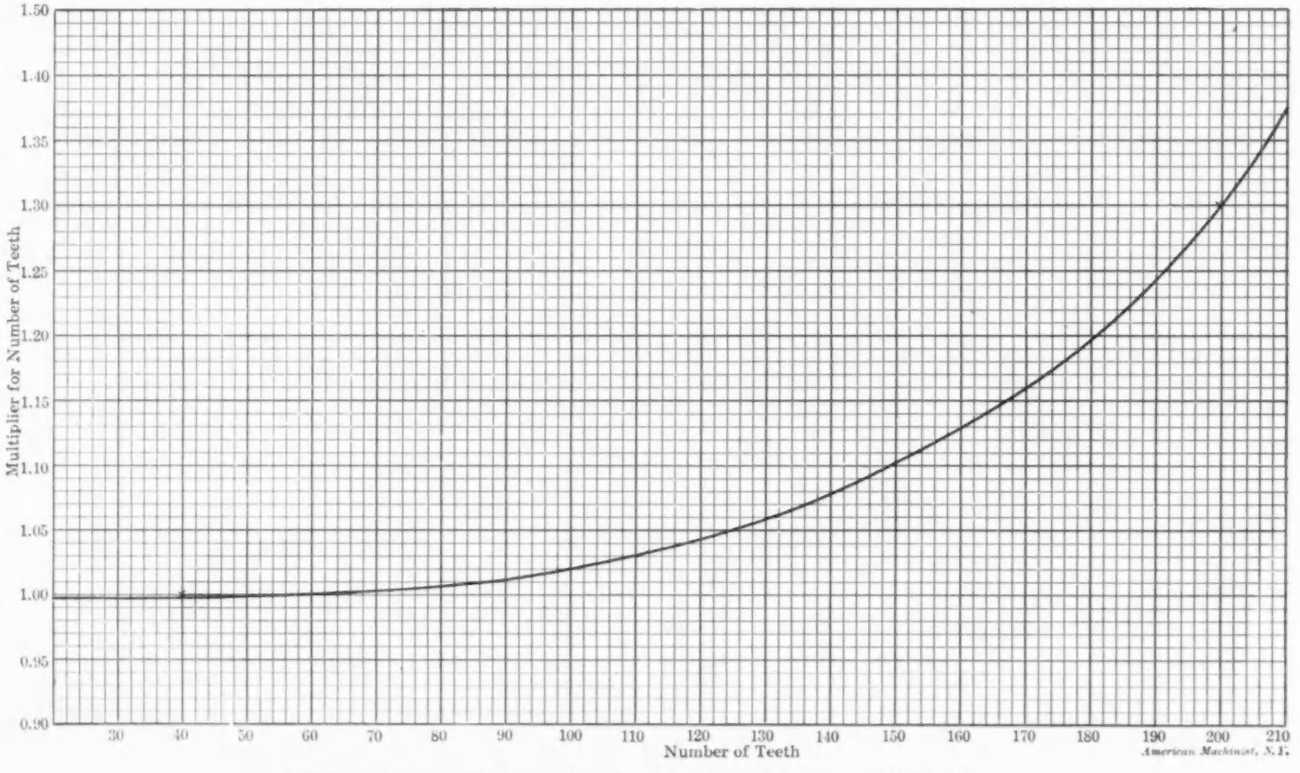


CHART I. MULTIPLIER FOR INCREASED NUMBER OF TEETH OF SPUR GEARS

outside diameter of the hub may be taken as 1.75 times the diameter of the bore.

From the foregoing it is obviously almost as important that the hub should not be disproportionately heavy as that it should be heavy enough. But, if, for any reason, a materially heavier hub is required it should be split, by means of thin cores, into as many equal, radial sections as there are arms in the gear, thus obviating blow-holes, and strains caused by shrinking. Fill the cored spaces with babbitt or lead before machining; and shrink steel bands on the hub, for a grip on the shaft, see Fig. 2.

12. Number of Arms—There is no definite rule for this, as this point depends almost entirely upon the judgment of the designer. In general, however, gears up to 60 inches are either webbed, or with four or six arms to suit conditions; over 60 inches eight arms are generally used and over 80 inches in diameter, 10 arms. In no case should the greatest distance between the arms exceed the length of the arm measured from the center of the gear to its intersection with the rim.

13. Width of the Face—The face of

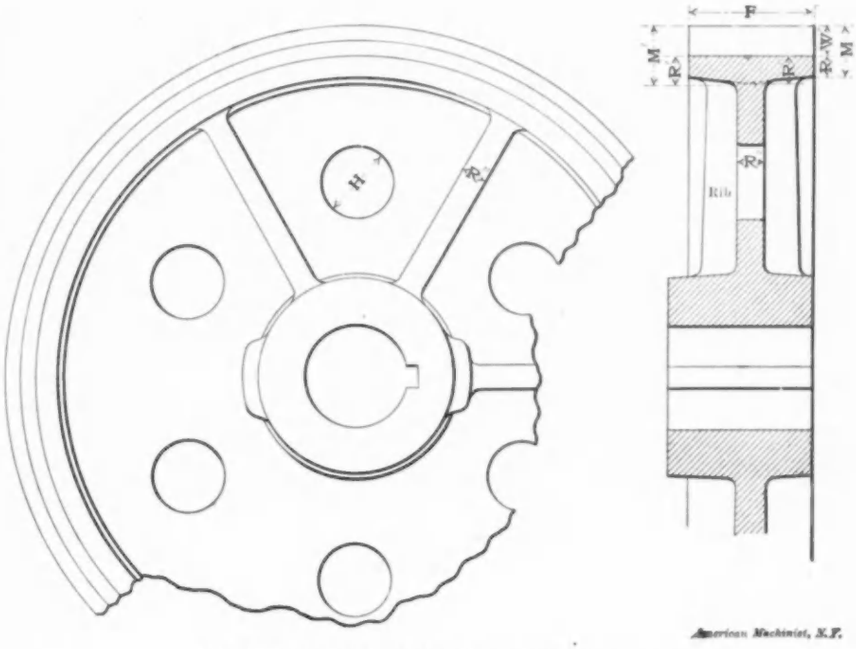


FIG. 3. PLAN AND SECTION OF WEBBED SPUR GEAR

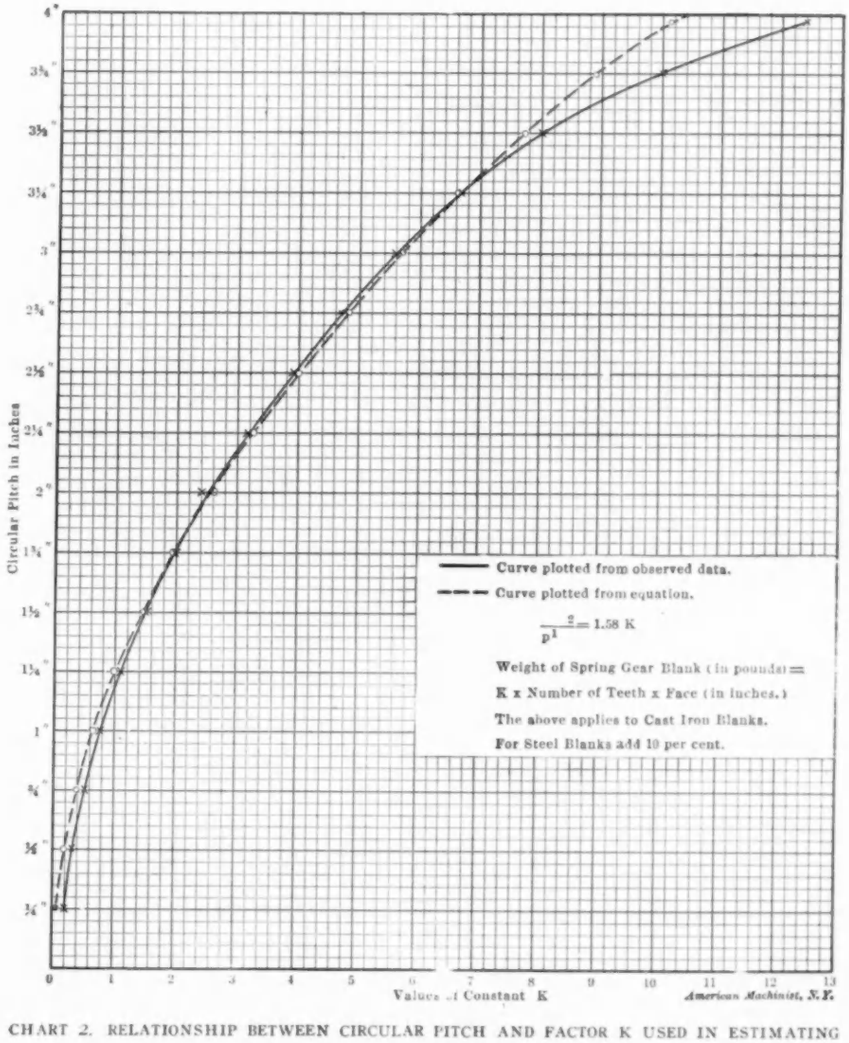

Circular Pitch in Inches
Values of Constant K
Curve plotted from observed data.
Curve plotted from equation.
$\frac{2}{p^1} = 1.58$ K
Weight of Spring Gear Blank (in pounds) =
K x Number of Teeth x Face (in inches.)
The above applies to Cast Iron Blanks.
For Steel Blanks add 10 per cent.
American Machinist, N.Y.

CHART 2. RELATIONSHIP BETWEEN CIRCULAR PITCH AND FACTOR K USED IN ESTIMATING WEIGHTS OF SPUR GEAR BLANKS

spur gear is generally estimated at about three times its circular pitch, as follows:

1	diametral pitch	9 inches face
1½	diametral pitch	7½ inches face
1½	diametral pitch	6 inches face
1¾	diametral pitch	5½ inches face
2	diametral pitch	5 inches face
2½	diametral pitch	4 inches face
3	diametral pitch	3 inches face
4	diametral pitch	2 inches face
5	diametral pitch	1¾ inches face
6	diametral pitch	1½ inches face
8	diametral pitch	1¼ inches face
10	diametral pitch	1 inches face
12	diametral pitch	¾ inches face
14	diametral pitch	⅝ inches face
16	diametral pitch	½ inches face
18	diametral pitch	⅜ inches face
20	diametral pitch	⅜ inches face

FIG. 4. FACE OF SPUR GEARS FOR VARIOUS PITCHES

It is becoming better understood, however, that a wider face is more efficient ("increasing the face does not increase the friction of the teeth in proportion"),* and as the wear of the teeth is governed by the diameter of the gear, or rather, by the combination of diameters and the width of the face, the face, therefore, should be amply wide, and the pitch just sufficient to resist fracture.

Street-railway gears are made 3-pitch, 5-inch face, with good results. A gear face of five times its circular pitch is now generally considered to be good proportion.

Webbed-spur Gears

No definite rule can be laid down for the design of webbed gears, see Fig. 3. Generally the thickness of the web is made equal to R'', which is the thickness of the rim at its thickest part.

Core holes H tend to make a sounder casting, and furnish means to secure the

*George B. Grant.

gear while turning. When these holes are made large, or are of shape to follow outlines of the arms and rim, ribs are added on each side. Care should be exercised, however, not to make the arm too light, for when the hub is heavy the light section connecting the rim and hub will cool too rapidly, setting up serious shrinkage strains, and causing flaws in the casting that cannot be remedied by annealing. Sharp corners, small fillets and narrow ribs should be avoided for the same reason.

Split Spur Gears

It is not good practice to split a gear between the arms, but when this is necessary, the following points should be kept in mind, see Fig. 5:

1. Bolts should be placed as close to the rim as possible.

2. The dimension *b* must, in no case, be less than the dimension of *a;* otherwise the bolts will be subject to other than the direct tensile stress tending to spread the gear.

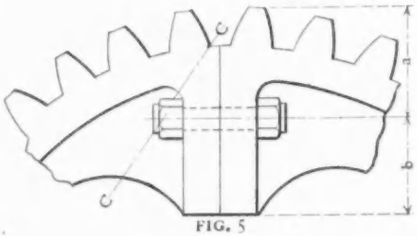


FIG. 5

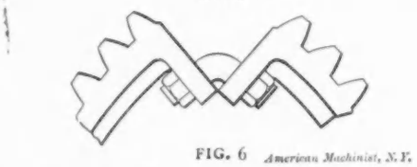


FIG. 6 *American Machinist, N.Y.*

DIAGRAMS ILLUSTRATING SPLITTING OF GEARS AT THE RIM

3. Section *C-C* should be stiff enough to resist any strain tending to bend the lugs. By placing the bolt close in the corner of the rim and the lug the length of the lug may be reduced, as (2) this lug need only be long enough to counteract leverage on bolt.

4. The bolts should be sufficiently heavy to carry the load applied at the pitch line of gear tooth, not neglecting the initial stress set up by the tightening of the nut, which is generally neglected, sometimes disastrously. When a bolt is placed close in the corner it is necessary to use a stud bolt drawing up the nuts as the gear halves are brought together.

When the dimension *b* is shorter than *a*, Fig. 5, as is generally the case, the load on teeth of gear will cause a fracture of the rim, as illustrated in Fig. 6.

The best method of splitting gears is through the arm, as illustrated in Fig. 7, which is a cut of the type used on street railways. When the gear is large, Fig. 8 illustrates a good average design.

When splitting a gear of an odd number of teeth, the split should be made ¼ of the circular pitch off the center line. This will bring the split through the center of two of the tooth spaces. It is good practice to spline the adjoining surfaces, as illustrated in Fig. 7, instead of using fitted bolts or depending on dowel pins. A spline ¾ inch wide and ⅛ inch high will answer for any but the largest gears.

One point that must be considered in designing split gears for high speed is the fact that weight at any point or part of the rim, and not integral to the rim proper (as lugs for bolting, see Fig. 7), locates the bending moment, and if safe speed is exceeded to the moment of fracture, it will occur at or near such weight.

This fact is pointed and explained by Charles H. Benjamin, in an article in the American Machinist of December 26, 1901, entitled "The Bursting of Small Cast Iron Flywheels."

advocate a connecting-rod section, such as is illustrated by Fig. 9, for smaller gears.

Connecting-rod-arm Spur Gear

This design could be applied to gears of all sizes: As the face increased, the section could be changed—as per dotted lines. This, however, would allow a central rib instead of two ribs on each side of the rim as when the ⊢ is turned the other way (see Fig. 3), but would allow the use of bolts instead of links when a split gear had no hub projections. This design is illustrated by Fig. 10.

For gears of an extremely wide face it will be found that formula 8 for arm will give a section that cannot be contained in the space between hub and rim. This practically means making a web gear. However, when the face is wide it would seem better to use a light web, say, according to dimension on Fig. 3, and extending

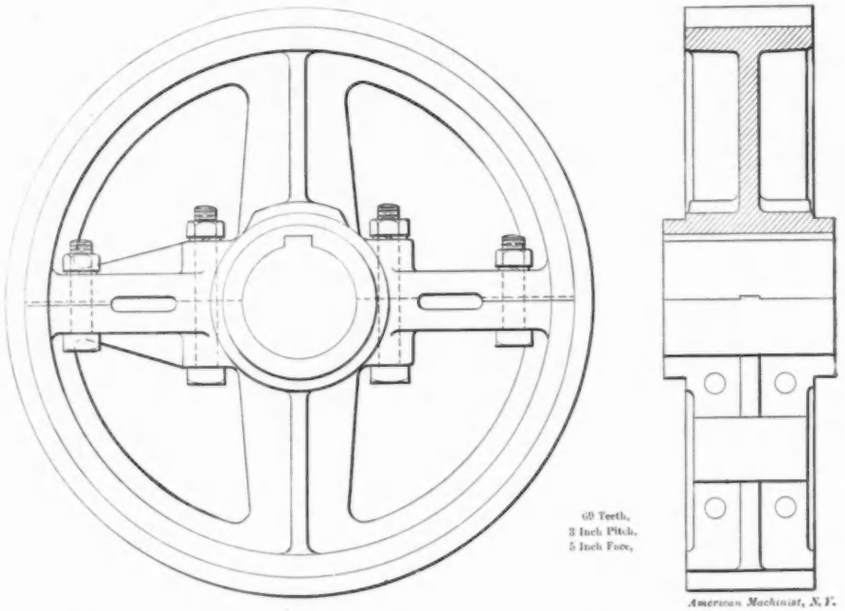


FIG. 7. PLAN AND SECTION OF AVERAGE DESIGN OF SPLIT RAILWAY GEAR

I-shaped Arms

For gears such as are shown in Fig. 2, the proportion of rim, arms and hub may be determined according to formulas given above, the area of arms, of course, being contained in an I instead of an elliptical section. For gears of this size, however, there is more variation in the weight of the gear and the values cannot be followed so closely.

The I-section arm is much more desirable in heavy gears because it distributes the metal contained in a section of the arm over a greater surface of the rim at their intersection than does the elliptical arm, and, therefore, lessens liability of blow holes at this point. Aside from this, it gives better support to rim in case the face is wide, and makes a stronger section than the elliptical with the same weight of material.

For the above reasons I am disposed to ribs toward the side, making a cross-sectioned arm, or using the section shown by Fig. 2. This section is generally the most desirable, but this depends upon conditions.

The formulas given here will form a basis for the design of worm and bevel gears, although I believe that the I or cross-shaped section is superior to the oval arm for worm gears on account of the side strain encountered.

For Calculating Weight

The accompanying table gives a rapid, approximate method of calculating the weight of a spur-gear blank with oval arms, designed according to the above formulas.

This table was derived from a formula by Reuleaux, which gives the weight of a cast-tooth gear from the combined product of a constant for the number of teeth.

face and square of the circular pitch, as Table 1.

The approximate weight of gear wheels W may be obtained from the following:

$W = 0.0357\ b\ c^2\ (6.25\ N + 0.04\ N^2)$,

where b = face, c = circular pitch, N = number of teeth, and W = weight of gear.

The following table will facilitate the application of the formula; it gives the value $\frac{W}{bc^2}$ for the number of teeth which may be given, and the weight may be readily found by multiplying the value in the table by $b\,c^2$:

N	0	2	4	6	8
20	5.04	5.60	6.18	6.77	7.38
30	7.99	8.61	9.24	9.89	10.52
40	11.09	11.90	12.59	13.30	14.02
50	14.74	15.48	16.23	17.00	17.77
60	18.55	19.35	20.15	20.97	21.80
70	22.65	23.50	24.36	25.24	26.12
80	27.02	27.93	28.85	29.79	30.73
90	31.69	32.66	33.63	34.62	35.63
100	36.63	37.67	38.70	39.75	40.81
120	47.40	48.54	49.69	50.85	52.03
140	59.30	60.56	61.82	63.10	64.27
160	72.35	73.73	75.10	76.39	77.90
180	86.54	88.03	89.52	91.02	92.54
200	101.88	103.48	104.98	106.70	108.34
320	118.36	120.08	122.15	123.52	125.27

Example: A gear 50 teeth 2 inches pitch, 4 inches face we have bc^2 $14.74 = 4 \times 2^2 \times 14.74 = 235.84$, say 236 pounds.

TABLE 1. WEIGHT OF CAST IRON GEARING.

REULEAUX.

I first tried changing the value of the constants for the number of teeth, but found that the square of the pitch (C^2) was not a correct factor, and a separate table was made up for it.

After repeated trials and corrections in the value of the constant for the number of teeth, it was noticed (when close results were finally obtained) that these values ran parallel with the number of teeth, and were, therefore, dropped; changing the value of the constants for the square of the pitch as called to obtain like results.

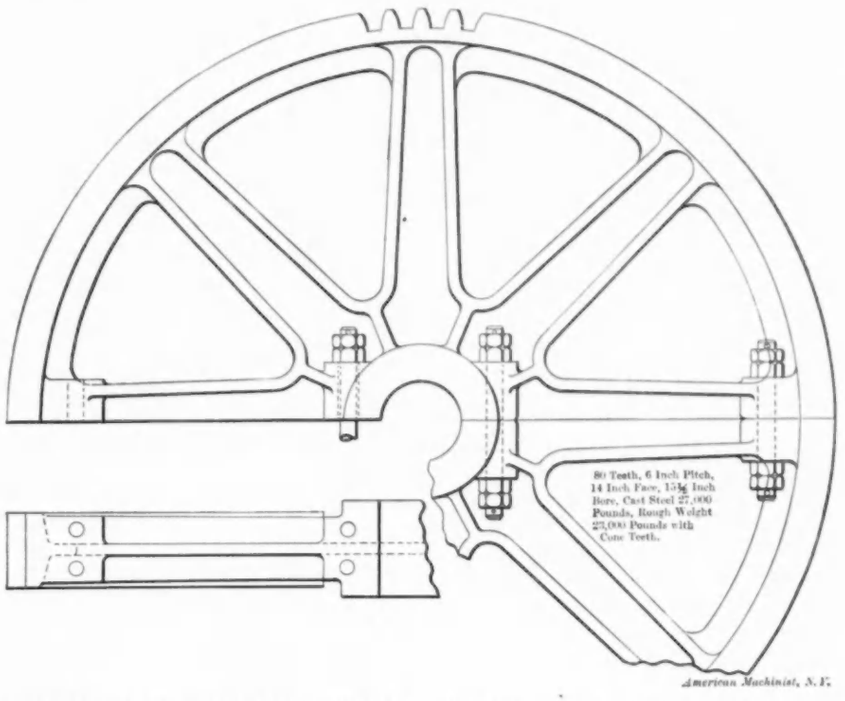

80 Teeth, 6 Inch Pitch, 14 Inch Face, 1⅝ Inch Bore, Cast Steel 27,000 Pounds, Rough Weight 27,000 Pounds with Cone Teeth.
American Machinist, N.Y.

FIG. 10. PLAN AND SECTION OF LARGE SPUR GEAR WITH CHANNEL-SHAPED ARMS

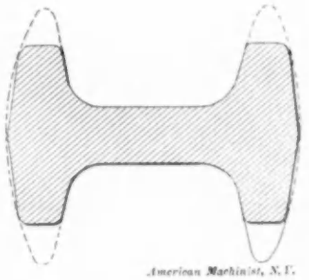


FIG. 9. SUGGESTED CONNECTING-ROD SECTION

To find the weight, therefore, it is only necessary to find the combined product of the number of teeth, face, and a constant given for the pitch:

Weight = number of teeth $\times F \times K$.

The accompanying Chart 2 gives the value of K.

This formula has its limitation; it cannot be used for low numbers of teeth varying with the pitch. Also for large gears there is a variation in design that cannot well be covered by one constant. However, the proper constant may be readily determined by trial for different constructions. In general it must be used with discretion, but is invaluable as a check. The finished weight is found by deducting 30 per cent.

The following equation seems to give a close approximation to the curve of Chart 2 throughout the ordinary working range up to 3½ inches circular pitch:

$$p'^2 = 1.58\ K$$

in which p' is the circular pitch and K the constant previously referred to. Transposing we have

$$K = \frac{p'^2}{1.58},$$

or substituting in equation for weight of spur gears,

$$Weight = \frac{p'^2}{1.58} \times number\ of\ teeth \times face.$$

Beyond 3½ inches circular pitch there is considerable variation between the curves

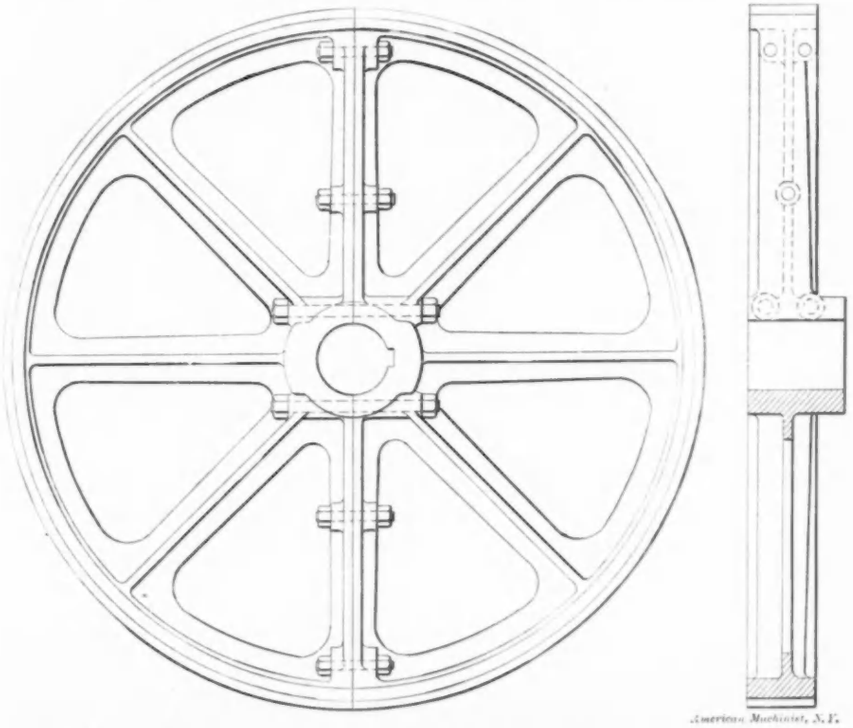


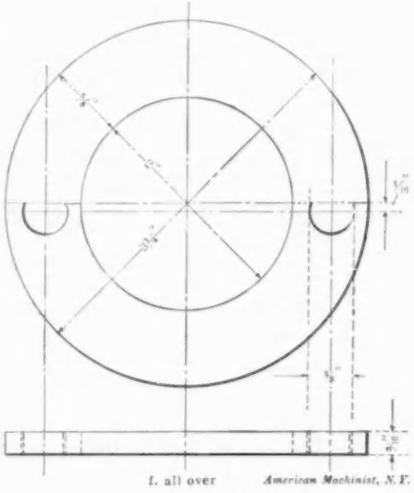
FIG. 8. PLAN AND SECTION OF AVERAGE DESIGN OF LARGE SPLIT RAILWAY GEAR

from the actual data and from the equation. However, as I have stated for large gears the variation in design cannot well be cared for by a single constant. In using the formula its limitations should be carefully understood. As a matter of interest, it might be stated that for 6 inches circular pitch the curves are again practically in agreement.

A Snap Washer

By J. B. Chipman

For some reason there are drill presses made without having any provision for taking up the wear between the thrust collar and the quill. In time this wear will cause trouble, by allowing the drill to pull in just as it is breaking through. When the shop is busy repairs cannot be easily made, and the thrust collar of the machine I have in mind cannot be easily



A SNAP WASHER

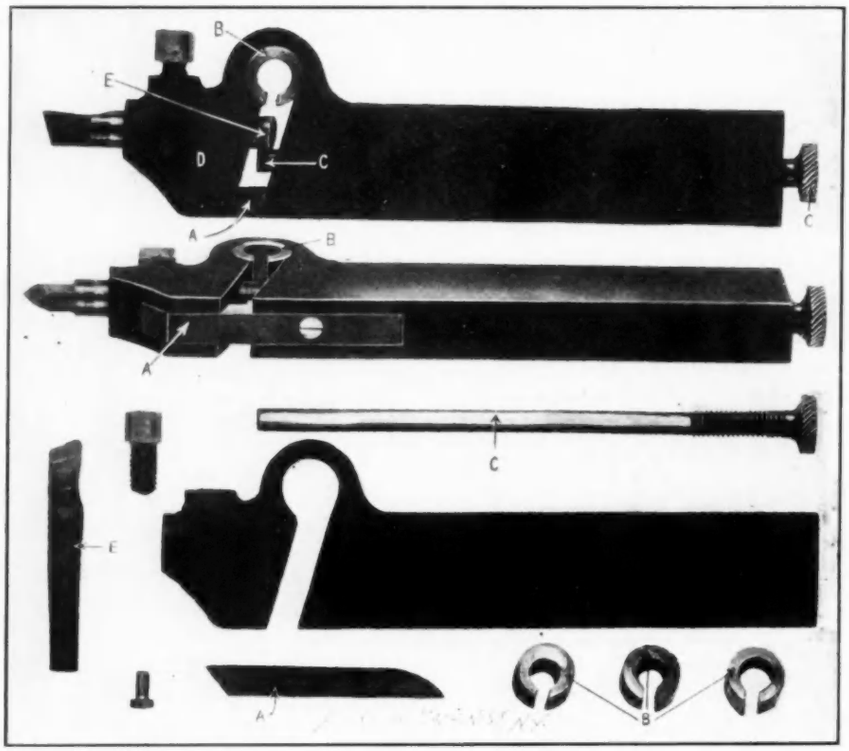
removed anyway. The cut shows a very good way to make this, or any similar repair. From sheet brass make two solid washers full size. One-sixteenth of an inch below the center, drill and ream the two ⅜-inch holes, as shown, cut the washer on the center line, and retain the half containing the larger portion of the holes. The other washer should be cut one-quarter inch below its center line, cut the round portions, corresponding to the ⅜-inch holes, and file to fit. Grind off the burs on the sides and it is then ready to be applied. If you have any difficulty in snapping it together on the spindle, try the persuasive qualities of a wooden clamp.

The export trade in machinery of the various kinds showed an improvement for the month of June over the same month in 1908. In June, 1908, machinery exports amounted to $1,738,036, while June of 1909 amounted to $2,026,876.

An Improved Spring Threading Tool Holder

The tool holder shown in the accompanying illustration has recently been designed by James Flannery, 29 Columbia street, Newark, N. J. It is of the gooseneck, spring type, and has many novel features that would recommend it for use.

One of the points wherein it differs from all other tool holders of this type is in the milling of a slot in the bottom and the insertion of the piece *A* in this slot to prevent the tools from springing sideways. Every mechanic who has had occasion to use this style of tool holder knows the trouble that is sometimes caused by its springing sideways and causing the tools to creep up on the side of the thread, thus making it difficult to turn a true thread. The insertion of the piece *A*, which is a sliding fit in the slot, overcomes this difficulty and makes the holder as rigid as a solid one.



FLANNERY'S IMPROVED GOOSENECK TOOL HOLDER

Another feature is the insertion of the different-sized split bushings, as shown at *B*, in order to give the tool holder more or less spring according to the requirements of the work. These bushings are held tight by the holder when it is at rest, and can be removed for the insertion of another in its place by screwing in the rod *C*, which has a nurled knob at the end of the holder. This forces the rod *C* against the front of the tool holder *D* and springs it out far enough to release the bushing and insert another. By leaving the rod *C* pressing against the front *D*, it makes it work like a solid holder, as the spring in the gooseneck and bushing cannot act. This can also be accomplished by shoving the tool back into a countersunk hole at the back end of the slot. Then both the rod *C* and the tool *D* can be used to prevent the spring from working.

The simplicity of the construction of this tool is shown in the lower part of the illustration, in which all of the pieces which enter into its construction are shown unassembled. Aside from the cutting tool there are but five pieces to make, namely, the body, the rod *C*, the bar *A*, and the three bushings *D*, and all of these are simple and easily made. Besides this two standard stock screws are required to put it together, as shown. If desired, the body of the holder could be made heavier over the split and the bushings done away with. This would leave but three pieces to make and two screws to buy to complete the tool holder.

The tools for holder of the size shown are made of 5/16-inch rod, and as many different sized and shaped tools can be made as are needed for the different threads to be cut.

According to a bulletin issued by the U. S. Geological Survey, the water powers developed in the United States amount to about 5,300,000 h.p. and include ten powers of more than 40,000 h.p., six of more than 60,000, and three of 100,000 or more. The average per wheel is about 100 horsepower.

Some Notes on Tests for Hardness*

Hardness of Different Metals As Shown by Turner's Sclerometer, Shore's Scleroscope, Brinell's Test and Keep's Test. Kind of Hardness Measured

BY THOMAS TURNER

Few properties of iron and steel are of more importance than that of hardness. In some cases, as with a cutting tool or a pressure die, the metal is practically valueless unless it can retain a sharp edge; while in other instances, where the material has to be machined or cut and trued to shape, even a relatively slight increase of hardness is the cause of much inconvenience and expense. In a third class of material a good wearing surface is of prime importance; while, lastly, hardness may often serve as an indication of a degree of brittleness and untrustworthiness which might perhaps be otherwise unsuspected.

Hardness may be defined as the property of resisting penetration, and, conversely, a hard body is one which, under suitable conditions, readily penetrates a softer material. There are, however, in metals various kinds or manifestations of hardness according to the form of stress to which the metal may be subjected. These include tensile hardness, cutting hardness, abrasion hardness, and elastic hardness; doubtless other varieties could also be recognized when the experimental conditions are modified so as to bring into operation properties of the material in addition to that of simple, or what may be conveniently called mineralogical hardness. This has been defined by Dana as "the resistance offered by a smooth surface to abrasion."

The usual quantitative tests for hardness are static in character, but the conditions are profoundly modified when the penetrating body is moving with greater or less velocity. The resistance to the action of running water; to the effect of a sand-blast; or to the result of the pounding of a heavy locomotive on a steel rail, afford examples of what might perhaps for purposes of distinction be called dynamic hardness, which is a branch of the subject that has received little quantitative examination.

Relation of Atomic Volume to Hardness

Just as the pressure of a gas, at a given temperature, is proportional to the number of molecules in a unit space, so in the case of a homogeneous solid substance, such as a pure metal, it may be assumed that the resistance to the entry of another body will increase as the number of atoms in a unit volume increases. Hence, as originally pointed out by Bottone in 1873, hardness varies inversely as the atomic volume. In other words, soft metals have a high and hard metals a low atomic volume. This can perhaps be best seen when the common metals are arranged in four groups, which may be called hard, medium hard, soft, and very soft respectively, thus:

	Atomic Volume.
Nickel	6.7
Cobalt	6.9
Manganese	6.9
Iron	7.2
Copper	7.2
Chromium	7.7
Group 1. Hard.	
Zinc	9.1
Platinum	9.1
Gold	10.2
Silver	10.2
Aluminum	10.6
Group 2. Medium.	
Cadmium	12.9
Magnesium	13.8
Tin	16.1
Lead	18.1
Bismuth	21.1
Group 3. Soft.	
Sodium	23.7
Potassium	45.4
Group 4. Very Soft.	

This rule does not rigidly hold good in all cases, but it would probably be more nearly universal if the metals were tested at a temperature suitably removed from their melting point. Calcium, for example, has an atomic volume of 25.4, and might therefore be expected to have a low melting point, and to be soft. On the contrary, it melts in the neighborhood of 900 degrees Centigrade, and its hardness is about 9 on the scleroscope scale. It is, in fact, hard enough to require a metal saw or a cold chisel. Doubtless it would be much softer if it were tested at, say, 150 degrees or 200 degrees below its melting point, when it would more nearly resemble tin or lead at ordinary temperatures.

Hardness of Alloys

It is well known that many alloys are harder, and consequently wear better than either of their constituent metals. Familiar examples of this characteristic are met with in gold and silver coinage alloys, and in the bronzes. The zinc-copper series also yields alloys harder than either zinc or copper. One alloy in this series, prepared in my laboratory in a very interesting series of tests recently conducted by M. T. Murray, was found to have a hardness just twice as great as that of mild steel.

The general principles in relation to the hardness of alloys have hitherto been but little studied, and are only now beginning to be understood. Dr. C. Benedicks has suggested the general rule that the hardness of solid solutions (alloys) becomes greater as the osmotic pressure increases, and has supplied some examples in support of this contention.

The results of experiments conducted by two Russian investigators, and lately published, appear to show that when two metals unite to form a solid solution there is an increase of hardness. When the two metals form a continuous series of mixed crystals, the curve of hardness is a continuous one which passes through a maximum, and this point of maximum hardness generally corresponds with that of minimum electric conductivity. When the metals form alloys which solidify as a mechanical mixture of two components the hardness curve is approximately a straight line. When the metals form only a limited series of mixed crystals the curve of hardness is a combination of the two forms previously mentioned; while, lastly, if the two metals form a definite chemical compound this may be either harder or softer than the constituents.

In many of the iron and steel alloys a continuous series of mixed crystals is obtained, and as a result there may be expected a continuous hardness curve, with a maximum at a given proportion. As heat treatment leads to the formation or decomposition of solid solutions, the resulting hardness will naturally vary according to the nature of the change which takes place.

Early Attempts to Measure Hardness

In a standard textbook on physics, by Daniell, published 25 years ago, it was stated that "Hardness is a property that cannot be measured." Originally the file or the tool was the only kind of instrument used for such tests, and metal was classed as "soft," "hard," "very hard," and so forth.

Réamur, in 1722, described two methods of testing the relative hardness of steel. In the first, a bar of steel was divided into equal lengths by parallel straight lines, and one end of the bar was hardened. The steel to be tested was made into the form of a graving tool, and the particular division on the bar which it was able to mark was noted. In the other method the two pieces of steel which were to be compared were shaped into small test bars, the section of which was a right-angled triangle. These bars were so placed that the edges could be pressed together, and the depth of the indentation was taken as a measure of the relative hardness. These are the earliest recorded attempts

*Paper read before the Iron and Steel Institute, England.

at a quantitative measure of hardness with which I am acquainted.

To the mineralogist we owe the first definite numerical scale (Mohs'), and the use of the sclerometer. To the officers of the United States ordnance department in 1856 we owe the method of indentation with a weighted punch, and the measurement of the volume of the indentation so obtained. Engineers have introduced drilling, grinding, and rubbing tests, but to German physicists we chiefly owe the modern conception of an absolute scale of hardness expressed in terms of the stress per unit area which is required in order to produce penetration. Those interested in the bibliography of the subject will find numerous references in the author's paper on "The Hardness of Metals," published in the *Chemical News* in 1886; in the paper on a microsclerometer by Jaggar in the *Amer. Journ. Sci.*, 1897, vol. iv, p. 399, and particularly in the reports prepared by Mr. Osmond in 1893 for the "Commission des Méthodes d'Essai."

Comparison of Methods

For the purposes of this brief paper comparison will be made of only four typical methods of measuring hardness. Those selected include the sclerometer, introduced by the author in 1886; the scleroscope, recently invented by Shore; the form of indentation test adopted by Brinell about 10 years ago; and the drill test introduced by Keep a few years earlier.

Each of these methods has been used in actual works practice, and by various persons other than the inventor, and may thus be regarded as being typical of the particular class of test to which it belongs. Among the many other forms of test the microsclerometer and wearing tests call for special mention, though to these only incidental reference can be made. The principles underlying the four methods selected for comparison may be briefly described as follows:

(1) *Turner's Sclerometer*—In this form of test a weighted diamond point is drawn, once forward and once backward, over the smooth surface of the material to be tested. The hardness number is the weight in grams required to produce a standard scratch. The scratch selected is one which is just visible to the naked eye as a dark line on a bright reflecting surface. It is also the scratch which can just be felt with the edge of a quill when the latter is drawn over the smooth surface at right angles to a series of such scratches produced by regularly increasing weights.

(2) *Shore's Scleroscope*—In this instrument a small cylinder of steel, with a hardened point, is allowed to fall upon the smooth surface of the metal to be tested, and the hight of the rebound of the hammer is taken as the measure of hardness. The hammer weighs slightly over 2 grams, the hight of the rebound of hardened steel is in the neighborhood of 100 on the scale, or about 160 millimeters, while the total fall is about 10 inches or 26 centimeters.

(3) *Brinell's Test*—In this method a hardened-steel ball is pressed into the smooth surface of the metal so as to make an indentation of a size such as can be conveniently measured under the microscope. The spherical area of the indentation being calculated, and the weight being known, the stress per unit of area when the ball came to rest is calculated, and this gives the hardness number. Within certain limits the value obtained is independent of the size of the ball, and of the amount of pressure. In the original tests the steel ball was 10 millimeters diameter, and the pressure was equal to a weight of 3000 kilograms, but a more convenient form of apparatus is now supplied by Mr. Brinell for work tests, while Mr. Stead has introduced a small and portable instrument. L. Grenet has also recently described a simple method of performing comparative ball-indentation tests with the use of an ordinary vise or press.

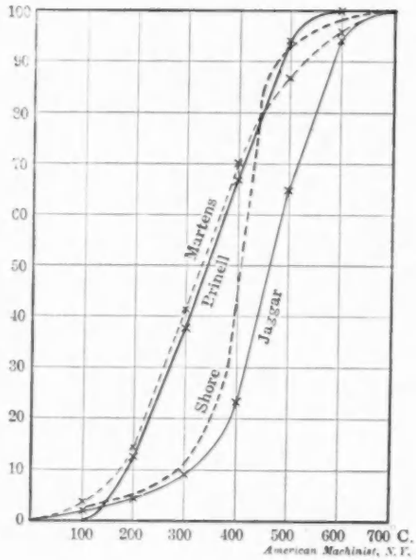


FIG. 1. PERCENTAGE LOSS OF QUENCHING HARDNESS ON REHEATING TO VARIOUS TEMPERATURES

(4) *Keep's Test*—In this form of apparatus a standard steel drill is caused to make a definite number of revolutions while it is pressed with standard force against the specimen to be tested. The hardness is automatically recorded on a diagram on which a dead soft material gives a horizontal line, while a material as hard as the drill itself gives a vertical line, intermediate hardness being represented by the corresponding angle between 0 degree and 90 degrees.

Results Obtained with Scleroscope

Each form of test has its advantages and its limitations. The sclerometer is cheap, portable, and easily applied, but it is not applicable to materials which do not possess a fairly smooth reflecting surface, and the standard scratch is only definitely recognized after some experience.

The Shore test is simple, rapid, and definite for materials for which it is suited, and appears likely to have an important future. But further information is yet needed as to the exact property which is measured by this form of test. As shown by De Fréminville, the result obtained varies somewhat with the size and thickness of the sample, while if the test piece is supported on a soft material such as a plasticine the results are valueless. It may, however, be pointed out that india rubber gives a rebound of 23, which is equal to that of mild steel; while I have found light soft pinewood give a rebound of 40, which is nearly double as great as that of gray cast iron. Curiously enough, hard wood, like teak, gives a rebound of about 12, while some samples are considerably lower than this.

As illustrating the influence of the support, a sample of exceptionally hard-rolled copper about 1/25 inch in thickness, when supported on a block of hard steel, and tested with the blunt or "magnified" hammer supplied, gave a value of 30, which was increased to 34 when the copper was supported on wood. A sample of brass only gave a value of 17, and yet this brass would scratch the copper, while the copper would not scratch the brass.

From these results it is evident that the Shore test is only applicable to a certain class of substances. It appears to test what may be termed the "elastic hardness," and gives high results with metals in the "worked hard" or *écroui* condition; values which are not fully confirmed by the tool or by the sclerometer. My tests appear to show that good results are, however, obtained with glass and with porcelain, as well, of course, as with most metals.

Uses for Brinell and Keep Tests

The Brinell test is specially useful for constructive material; it is easily applied and definite, and is now of all hardness tests the one most employed. It appears to give satisfactory results with wood, but cannot be applied to very brittle materials, such as glass, or to hard minerals.

Keep's test is specially suited for castings of all kinds, as it records not merely the surface hardness, but also that of the whole thickness, and gives indications of blowholes, hard streaks, and spongy places. Obviously it can only be applied to materials the hardness of which is less than that of hardened steel.

A very important question arises in connection with these various tests, namely, as to whether there is any observed agreement between the results which are arrived at by such entirely dif-

ferent methods. It will be noticed that in each case an arbitrary scale is adopted. If the weights used on my own apparatus had been ounces instead of grams the hardness numbers would naturally have been different. Similarly Brinell's tests might have been expressed in tons and inches, or a different weight of hammer and hight of scale adopted by Shore.

Hence all that can be expected is a proportionality in the results, and if this is ascertained it should be possible to convert values on one scale into results on another. In the earlier experiments, conducted about half a century ago, this proportionality was markedly absent. Thus, comparing the researches of Calvert and Johnson with those of Bottone, we find:

	Calvert and Johnson.	Bottone.
Hardness of iron divided by hardness of copper..	3.0	1.0
Hardness of iron divided by hardness of lead....	58.0	2.5
Hardness of platinum divided by hardness of zinc.	2.0	1.0
Hardness of cadmium divided by hardness of tin..	4.0	1.0

CALVERT-JOHNSON AND BOTTONE.

Comparative Tests

An examination of results obtained by the four methods dealt with in this paper, however, shows that, for relatively pure metals in their cast or normal condition, there is a general agreement which must be regarded as remarkable. In Table 1, will be found, in the first column, results which were published in my original paper on the hardness of metals in 1886. In the second column are my own results with the Shore scleroscope, and these figures are in good agreement with those supplied by the maker of the instrument. In the third column are values taken from published results by Mr. Brinell and by Mr. Stead, but the numbers given have been divided by 6, as this figure has been found to suitably reduce the Brinell hardness values for purposes of comparison. In the last column reference is made to Mr. Keep's method.

Metal.	Turner (Sclerometer.)	Scleroscope.	Brinell / 6	Keep.
Lead.....	1.0	1.0	1.0	
Tin.....	2.5	3.0	2.5	
Zinc.....	6.0	7.0	7.5	
Copper, soft..	8.0	8.0	...	Angle
Copper, hard..	...	12.0	12.0	varies
Softest iron...	15.0	...	14.5	from
Mild steel.....	21.0	22.0	16–24	0° to 90°
Soft cast iron.	21–24	24.0	24.0	
Rail steel.....	24.0	27.0	26–35	
Hard cast iron.	36.0	40.0	35.0	
Hard white iron.....	72.0	70.0	75.0	
Hardened steel	...	95.0	93.0	

TABLE 1. HARDNESS SCALES COMPARED.

It will be observed that either by accident or design the scale adopted for the scleroscope is, for practical purposes, identical with that of the sclerometer, while Mr. Brinell's values are proportional, but about six times as great. The angles in Keep's tests are, or could easily be made, in pretty close agreement with the other values. It would therefore appear that each instrument, with simple and homogeneous substances, must measure one and the same physical property, and gives results which are either in actual agreement with, or proportional to, the results obtained by the other forms of test.

Agreement of Tests

In practice, however, the use of relatively pure metals in the unworked or annealed condition is comparatively rare, unless we include in this category wrought iron and mild steel. Carbon steels and special steels consist largely of solid solutions, the complexity of which is profoundly modified by heat treatment; while copper, zinc, and their alloys are frequently hardened by rolling, drawing, or other mechanical treatment.

The very important question therefore arises as to the extent to which the different methods of testing agree in their values for the hardening and tempering of steel, and for *écroui* or hardness caused by mechanical treatment. From preliminary observations on the latter point I am inclined to believe that metal which has been mechanically treated, as with hard-drawn rods or rolled sheets, has its tenacity increased out of proportion to its hardness as measured by a file or cutting tool. The sclerometer shows relatively little difference, for example, between hard-drawn and annealed copper, while the scleroscope shows an exaggerated effect, at all events in some cases. As the Brinell test closely follows the tenacity, it too may be expected to show marked differences between worked and annealed samples.

The result in some cases is likely to be a confusion between the elasticity or tenacity on the one hand, and true or mineralogical hardness on the other. For example, a piece of hard-rolled copper may give a greater hardness number than one of mild steel. Yet a tool made of mild steel will always cut copper, and no amount of cold-rolling will make copper cut steel. Hence great care is required when hardness values for different materials are compared, and further information in this direction is desirable.

Difficulties Encountered in Testing Hardened Metals

The question of agreement in reference to the true hardness of a sample of steel in the normal, hardened, tempered, or annealed condition is perhaps of even greater importance. To illustrate the kind of difficulty which arises, reference may be made to some recently published results by E. Maurer, in which samples of steel with varying content of carbon were heated to ascertained temperatures, quenched, and afterward tempered or annealed at given temperatures. The hardness of the samples was then determined.

When the tempering heat was 300 degrees Centigrade, the loss of hardness in a sample containing 0.83 per cent. of carbon was 11.1 per cent. by the Shore method, and 38.0 per cent. by the Brinell test. A steel with 0.95 per cent. carbon tested in a similar manner by Heyn and Bauer with a Martens sclerometer gave a loss of hardness of 41.0 per cent.; while lastly Boynton, with a Jaggar sclerometer, using a steel with 0.86 per cent. carbon, has recorded a loss of hardness on tempering at 300 degrees of only 9.1 per cent.

The question may be put in this way: The steel is suited for making woodworking tools, if properly hardened and tempered. Is 300 degrees Centigrade a proper tempering heat? According to the Shore test and the Jaggar test, the tool should be hard and cut well; but according to the Brinell test and the Martens sclerometer it has lost nearly half its original hardness, and should rapidly lose its cutting edge. Maurer states that everyday experience shows that with this class of steel tool a tempering heat of 300 degrees renders the metal useless for woodworking.

The results of the four sets of experiments are given in Table 2.

Temperature of Heating.	Brinell Method (0.83 Per Cent. Carbon).	Martens Sclerometer (0.95 Per Cent. Carbon).	Jaggar Microsclerometer (0.86 Per Cent. Carbon).	Shore's Method (0.83 Per Cent. Carbon).
Deg. C.				
160	...	2.5	1.8	3.7
200	13	14.0	5.4	2.7
300	38	41.0	9.1	11.1
400	68	70.6	23.6	33.0*
500	94	87.5	64.0	92.5
600	100	95.7	94.5	100

*At 380 degrees.

TABLE 2 PERCENTAGE LOSS OF QUENCHING HARDNESS ON TEMPERING.

The values are graphically represented in Fig. 1, from which it will be seen that the greatest difference occurs at about 300 degrees Centigrade, the loss of quenching hardness due to tempering being returned as about four times as great when tested by the two first methods as compared with the results obtained when the steel is tested by the two latter methods given in the table.

Results of Brinell Test on Hardened Steel

Further, Martens and Heyn have recently pointed out that in the ball test for hardness the indentations are frequently not circular, and are therefore difficult to measure, and that when testing hard materials the ball itself is appreciably flattened while under load. To diminish these sources of error, Martens has introduced a special form of apparatus for measuring the depth of the indentation. The re-

sults of tests with this machine on a sample of tool steel containing 0.95 per cent. of carbon were as follows:

	HARDNESS NUMBER.
Forged steel	277
Heated to 900° and water-quenched	2,775
Heated to 900° and reheated to 100°	2,775
Heated to 900° and reheated to 200°	2,285
Heated to 900° and reheated to 275°	1,060
Heated to 900° and reheated to 400°	595
Heated to 900° and reheated to 500°	446
Heated to 900° and reheated to 700°	277

From these figures it appears that the increased hardness due to quenching was 2775 — 277, or 2498, while this was reduced by tempering at 275 degrees to 1060 — 277, or to 783. In other words, the steel, when tempered at 275 degrees, retained only 31 per cent. of the additional hardness due to quenching, the loss in this case being about twice as great as that given by Maurer when similar metal was tested by the Brinell method and by the sclerometer.

It is evident, therefore, that further research and comparison is required before agreement in principle can be arrived at with hardness tests for hardened, tempered, or mechanically treated metals.

Court of Patent Appeal

By E. J. Stoddard

The American Bar Association has recently held its annual meeting at Detroit, and the action in regard to patents is of interest. Below is reprinted the report of the section on patent, trade-mark and copyright law in regard to the proposed court of patent appeals. The patent law section also passed a resolution that a committee should be appointed to coöperate with the general committee to suggest remedies and formulate proposed laws to prevent delay and unnecessary cost in litigation.

I attended a meeting of the patent section and advocated the inclusion in the bill for the court of appeals a provision for two scientific or expert assessors, one to sit with the court hearing cases, the other with the judge or judges writing opinions. If this was influentially backed it would be included and would be the entering wedge to get a broader treatment of the subject of patent law and patent practice.

I pointed out in this connection that Judge Carpenter, recently of the Michigan Supreme Court, said in his opening address on courts of appeal, delivered before the general body, that courts of appeal were more apt to err upon questions of fact than upon questions of law, and that this was, seemingly, especially true in patent cases where the facts were of a scientific and practical nature and were very complicated and involved, and not always well presented for the consideration of a body of judges.

I called attention also to the remarks upon this general subject in Amos on "The Science of Law," pages 309-310, which concludes in part as follows: "It is possible that, in patent cases, even a special court, with scientific assessors to the judge, might be organized in some way after the model of foreign tribunals of commerce." (This book is dated 1891.)

Report in Regard to Court of Patent Appeals

To the American Bar Association:

Your committee on patent, trade-mark and copyright law beg leave to submit the following report in relation to the bill to create a United States court of patent appeals of which your committee, in obedience to the direction of the association, have been endeavoring to procure the enactment by Congress. The report of the committee submitted at the last meeting of the association stated the progress which had been made to that time in the Sixtieth Congress. In the Senate the bill was in the hands of the Committee on Patents. In the House it had been favorably reported by the Committee on Patents, and then referred to the Committee on the Judiciary, where it remained at the adjournment of the first session of that Congress. Promptly upon the assembling of the second session that committee gave a hearing to the friends of the bill, and later in the session reported it to the House with a recommendation that it pass. It is believed that it would have passed the House if it could have been reached. But the pressure of other business was such that it failed of consideration. Your committee recommend that it be reintroduced at the opening of the first regular session of the present Congress in the same form in which it was reported by the Committee on the Judiciary of the Sixtieth Congress. A copy of it in that form, which embraces the amendments recommended by the House Committee on Patents of the Sixtieth Congress, all which are acceptable to this committee, is hereto appended.

It is the belief of your committee that it wants but a continuance of the active interest taken in the subject by the members of this association during the last two years to secure the passage of the bill by the present Congress. Very few senators or representatives are familiar with the patent laws, courts, or practice. The pressure of other things upon their time and attention makes personal investigation of these subjects on their part practically impossible. They have to be guided by the judgment of others upon whom they rely. For information in such a case as this they naturally and properly look to the lawyers of the country. That assistance was freely given during the life of the last Congress. In its report two years ago your committee asked the general and active coöperation of the members of the association. About 500 of them signified their willingness to respond to that appeal, and did so with highly gratifying effect. The proposal to create a court of patent appeals has become a familiar one at the capital, and a large number of senators and representatives have expressed themselves as favorable to it. A continuance of interest in the subject by the members of this association will, as we believe, assure the enactment of the law.

Respectfully submitted,

Robert S. Taylor,
Arthur Steuart,
Otto R. Barnett,
Joseph R. Edson,
Frederick P. Fish.

A BILL

To Establish a United States Court of Patent Appeals, and for Other Purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that there is hereby created a United States Court of Patent Appeals, which shall consist of five judges, of whom four shall constitute a quorum, and shall be a court of record with jurisdiction as is hereinafter limited and established. Such court shall prescribe the form and style of its seal and the forms of its writs and other process and procedure as may be conformable to the exercise of its jurisdiction as shall be conferred by law. It shall have the appointment of the marshal of the court, who shall have the same powers and perform the same duties under the regulations of the court as are now provided for the marshal of the Supreme Court of the United States, so far as the same may be applicable. The court shall also appoint a clerk, who shall have the same powers and perform the same duties now possessed and performed by the clerk of the Supreme Court of the United States, so far as the same may be applicable. The salary of the marshal of the court shall be $3500 a year, and the salary of the clerk shall be $5000 a year, both to be paid monthly in 12 equal payments. The costs and fees now provided by law in the Supreme Court of the United States shall be the costs and fees in the United States Court of Patent Appeals; and the same shall be collected, expended, accounted for, and paid over to the Treasury Department of the United States in the same manner as is provided by law in respect to the costs and fees in the Supreme Court of the United States.

The court shall have power to establish all needful rules and regulations for the conduct of its business within its jurisdiction as conferred by law.

Sec. 2. That the President of the United States, by and with the advice and consent of the Senate, shall appoint a chief justice of said United States Court of Patent Appeals, and as vacancies occur

shall in like manner appoint others to fill such vacancies from time to time. The acceptance of that office by a judge of the circuit court or district court of the United States shall vacate his office as circuit or district judge.

SEC. 3. That upon the taking effect of this act the chief justice of the Supreme Court of the United States shall designate from among the judges of circuit and district courts of the United States four judges to sit as associate judges of the United States Court of Patent Appeals, two of them to sit for three years from the first day of the first term thereof, and two of them to sit for six years from the first day thereof, as associate judges of the same court for six years from the first day of the first term thereof. And after that, as the periods expire for which such designations shall have been made the chief justice of the Supreme Court of the United States shall fill the vacancies thus occurring by designation of the same or other judges from among the judges of the circuit courts and the district courts of the United States, to sit for periods of six years each. In case of the death, resignation, or disability of any associate judge of the said court, or of his resignation of his seat in said court the chief justice of the Supreme Court shall designate another judge of a circuit court or a distrct court of the United States to sit for the unexpired period for which his predecessor had been designated. The designation of a judge of the circuit court or district court of the United States to sit as associate judge of the United States Court of Patent Appeals must be with his consent, and his service in that court shall not vacate his office as judge of the circuit or district court, as the case may be.

SEC. 4. That a term of the United States Court of Patent Appeals shall be held annually at the city of Washington, beginning on the second Monday of October in each year, and the same may be adjourned from time to time as the court shall order. If at any time for the meeting of the court a quorum of the judges shall not be present, the judges present may adjourn the court, and, if necessary, adjourn again from time to time until a quorum appear. If at any sitting of the court the chief justice shall be absent, the associate judge senior in commission as judge of the circuit court of the United States, or senior in age in case of commissions of even date, shall preside. If no judge of a circuit court shall be present, the associate judge senior in commission as a judge of a district court of the United States, or senior in age in case of commissions of even date, shall preside. Until it shall be otherwise provided by Congress the sessions of the court shall be held in a building or rooms to be provided by the marshal of the District of Columbia, under the direction and approval of the attorney-general of the United States. The court shall by order authorize its marshal to employ deputies and assistants for himself and the clerk of the court and such criers, bailiffs and messengers, as the business of the court shall require, and to pay the salaries of such employees at rates of compensation not exceeding those paid for similar services in the Supreme Court of the United States, and to pay all other necessary incidental expenses of the court. The chief justice and each of the associate judges shall be entitled to employ a clerk, whose salary, at a rate not exceeding that allowed the clerks of the chief justice and associate justices of the Supreme Court, shall be paid as part of the expenses of the court. The court shall have power, in its discretion, to appoint a reporter and to fix by order his salary or other compensation and direct the form and manner of the official publication of its decisions.

SEC. 5. That the chief justice of the United States Court of Patent Appeals shall receive a salary of $12,000 per year. The circuit judges of the United States sitting as associate judges of the same court shall each receive the salary allowed him by law as a circuit judge, and in addition thereto during the time of his service as associate judge of the United States Court of Patent Appeals, but not longer, such additional sum as will make his entire compensation during that service $11,500 per annum. The district judges sitting as associate judges of the United States Court of Patent Appeals shall each receive the salary allowed to him by law as district judge, and, in addition thereto, during the term of his service as associate judge of the United States Court of Patent Appeals, but no longer, such additional sum as will make his entire compensation during that service $11,500 per annum. All the said salaries shall be payable in 12 equal monthly instalments. The time during which any judge shall serve in said court shall be deemed continuous service with that in any other court of the United States, before or after such service within the meaning and intent of Section 714 of the Revised Statutes. The additional compensation received by a circuit or district judge while sitting as associate judge of the United States Court of Patent Appeals shall not be taken into account in determining the amount to be received by him after retirement.

SEC. 6. That the United States Court of Patent Appeals shall have jurisdiction to hear and determine appeals and writs of error from final judgments and decrees in the circuit courts of the United States in cases arising under the laws of the United States relating to patents for inventions, and from final judgments and decrees in cases arising under the laws of the United States relating to patents for inventions rendered by any other court having jurisdiction under the laws of the United States to hear and decide such cases in the first instance:

Provided, however, that it shall have no jurisdiction in cases originating in the Court of Claims. All such appeals shall be taken within six months after the entry of the order, judgment, or decree sought to be reviewed. The practice, procedure, and forms to be observed in the taking, hearing, and determination of such appeals and writs of error shall conform to the practice, procedure and forms observed in like cases in the Supreme Court of the United States, subject to such rules and regulations as shall be prescribed by the court.

SEC. 7. That whenever, by an interlocutory order or decree in a circuit court of the United States or other court having jurisdiction under the laws of the United States to hear and decide in the first place cases arising under the patent laws, in a case in which an appeal may be taken from the final decree of such court to the United States Court of Patent Appeals, an injunction or restraining order shall be granted, or refused, or continued, or vacated, or modified, or retained without modification after motion to modify the same, an appeal may be taken from such order or decree by the party aggrieved to the United States Court of Patent Appeals: *Provided,* that the appeal must be taken within 30 days from the service of notice of entry of such order or decree; and it shall take precedence in the appellate court; and the proceedings in other respects in the court below shall not be stayed unless otherwise ordered by that court, or the United States Court of Patent Appeals, or a judge thereof, during the pendency of such appeal.

SEC. 8. That the chief justice and the associate judges of the United States Court of Patent Appeals shall each exercise the same powers in term and vacation in the allowance of appeals, supersedeas orders, and other matters incidental to the jurisdiction and business of the court as are now exercised by the chief justice and associate justices of the Supreme Court of the United States in relation to the business and jurisdiction of that court.

SEC. 9. That the decisions of the United States Court of Patent Appeals in all cases within its appellate jurisdiction shall be final, except that it shall be competent for the Supreme Court of the United States to require, by certiorari or otherwise, any such case to be certified to it for its review and determination with the same power and authority in the case as though it had been carried by appeal or writ of error from the trial court directly to the Supreme Court.

SEC. 10. That whenever any case shall have been certified from the United States Court of Patent Appeals to the Supreme Court of the United States, by certiorari or otherwise, it shall be, upon its determination by the Supreme Court, remanded to the circuit court of the United States or other court in which it originated for

further proceedings to be taken in pursuance of such determination. And in every case determined by the United States Court of Patent Appeals upon appeal or writ of error, the case shall be remanded to the circuit court of the United States or other court from whence it came, for further proceedings to be taken in pursuance of such determination.

SEC. 11. That all appeals and writs of error in cases in which appellate jurisdiction is by this act conferred upon the United States Court of Patent Appeals which shall have been pending without hearing in the United States circuit courts of appeals or other courts of appellate jurisdiction for less than three calendar months prior to the taking effect of this act shall be transferred from such circuit courts of appeals or other courts to the United States Court of Patent Appeals and be heard and determined in that court as though they had been taken there from the trial courts by appeal or writ of error without further payment for certifying the record or any new or additional docket or calendar fee; all other appeals and writs of error in cases in which appellate jurisdiction is by this act conferred upon the United States Court of Patent Appeals which shall be pending in the United Sattes circuit courts of appeals or other courts of appellate jurisdiction at the time of the taking effect of this act shall remain and be heard and determined by the courts in which they may be pending, respectively, as though this act had not been passed.

SEC. 12. That after the taking effect of this act no appeal or writ of error shall be taken from any circuit court or other court of the United States to any United States circuit court of appeals or other appellate court in any case in which an appeal or writ of error may be taken to the United States Court of Patent Appeals under the provisions of this act.

SEC. 13. That all laws and parts of laws inconsistent with the provisions of this act are hereby repealed.

SEC. 14. That this act shall take effect and be in force on the — day of ——, 19—.

One of the most effective methods for the surface treatment of concrete in architecture is that which involves removal of the mortar by acid or wire brushes so as to leave the aggregate bare. This procedure, however, according to *The Builder*, is not always suitable, and in consequence pigments are sometimes added to the rendering coat applied to the surface. As mortar or cement so employed is very liable to fall off in places after a time, various attempts have been made to produce white and colored varieties of cement. A process recently devised on the Continent for the production of white portland cement made with ordinary or ferruginous clay is to introduce from 2 to 5 per cent. of salammoniac into the slurry, the effect being to convert the iron into ferric chloride.

Professor Sweet's Equal Wearing Surfaces

BY WM. TAYLOR

I have been so busily engaged with other things demanding urgent attention that I have really not found time to make sketches to illustrate applications which I have made of Professor Sweet's principle of equal wearing surfaces. I must, therefore, ask you to be content with the few words which I can now find time to dictate.

LAPPING SCREW THREADS

One application of this principle is found in Professor Rowland's method of perfecting screws by lapping them with nuts of their own length.

GRINDING LENSES

The same principle is employed by lens grinders in finally adjusting the radius of curvature of the metal tools which are used as laps in grinding the glass. These tools are worked together in pairs, and if, being of the same diameter, they are worked together with equal overlap at each end of their motion, they maintain their curvature, but if this overlap is made unequal the tools may by this means have their curvature altered as may be required in finally adjusting them. It is this necessity for securing equal overlap of the wearing surfaces at each end of the range of motion which often constitutes the real difficulty in carrying out Professor Sweet's principle to perfection. Thus, for instance, in the case of the planing machine, it is necessary to set the work on the table in such position that the table overlaps each end of the ways, and this, though generally it may be secured, is not in every case practicable. Then, also, there is the question of the even distribution of the load to be considered.

PUNCH PRESSES

These as generally made and illustrated have their rams level with the bottom ends of the guide-ways when the ram is at the top of its stroke. The consequence is that as the ram descends it leaves the extreme bottom end of its wearing surfaces unworn, and while it may be on this account quite tight in its ways when the ram is up, it becomes inevitably slack when the ram is down and just at the moment when the punch is entering the die and should be under the accurate control and guidance of the ram in its bearings. Again, at the top end of the ram, it is common practice to have the ram longer than the guide-ways so that it comes level with the latter at the bottom of the stroke. In this way the projecting upper end of the ram is but little worn, and though in this case when the ram is down it results in making the ram tight in the guide-ways at this end, there is very little satisfaction in having the ram controlled at this point the furthest removed from the tools which need the control.

What I have had to do with punch presses, when struggling to get fine work from them, has been to scrape away a portion of the wearing surface at each end of the ram so that the surface remaining was equal in length to that of the guide-ways in which the ram worked, and so that these surfaces overlapped as nearly as possible equally at each end of the stroke. As however, the ram of a punch press is generally adjustable, one has to consider the effect of such adjustment on the overlap of the surfaces, and with a view of securing the utmost control of the press tools at the time when they come into action, viz., when the ram is down, it seems to me better to have the ram overlap the guide-ways a little more at the top than at its lower end, this being the very opposite of current practice.

SCREW MACHINE TURRET SLIDES

Similar difficulty has been experienced with the slides of screw machines used for very accurate work. These slides are often made so that the upper member which carries the turret has guiding surfaces longer than those of the lower member which carries it, and (just as in the case of the punch press already cited) the turning tools carried by such a turret are set free, and under least control by the slide, at the very moment when they should be most rigidly held. The remedy for this has been to cut away these superfluous ends of the upper sliding member in such a way that the length of the slide is the same on both members and that they overlap about equally at each end of their motion. But in this case again circumstances require that the motion should be varied, for while the turret slide is generally withdrawn to some fixed point for the rotation of the turret it is advanced to a point which varies with the work to be done, and this may call for some compromise in the matter of the lap at each end, and a compromise may be further necessary in view of the fact that the load on the wearing surfaces of such a slide is not equally distributed but is greatest at the forward end of the slide and occurs chiefly when the slide is in its forward position and the turret tools are at work.

It seems to me that there are many cases of this kind in which Professor Sweet's principle needs to be applied with caution, but that in the main his principle is of great value and deserving of much greater attention than is given to it by machine designers, who by its aid might very often make better machines for less money.

Leicester, England.

Practical Letters from Our Readers

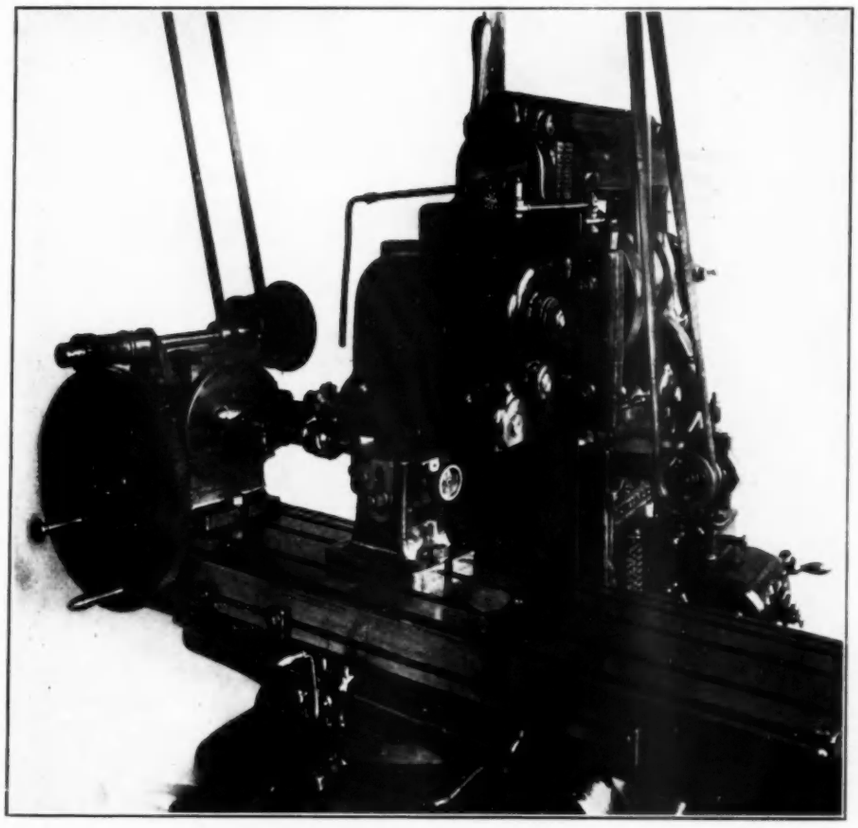
A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Thread Milling Scheme

The gear combination illustrated in the halftone was devised to overcome the well known inefficiency of the standard dividing head in cutting slow leads. With a slow lead the table feed screw revolves so slowly and the worm in the dividing head is required to revolve so rapidly that the power of the machine is to a large extent utilized in making these mechanical motions and very little is left for actual work.

This is so much the case that an attempt to give the work a reasonable commercial feed against the cutter may result in a wreck of the regular milling-machine feed.



DIVIDING HEAD GEAR FOR MILLING SLOW LEAD THREADS

By entirely disconnecting all the regular feeds, substituting the large gear for the regular index plate and driving it independently by means of the small pinion and clutch all trouble in getting a large days work was overcome and the work can be fed to the cutter at the full capacity of the cutter to stand it without any straining of the feed gears and shafts.

New York. A. L. SPARKS.

Indicating Capacity of Machine Tools

Every lathe builder has occasional requests for "raised" lathes and every planer builder for "widened" planers. Both are vexing questions. Many customers for either tool have good reasons to believe that what they are asking for will prove a profitable thing. One fortunate thing is that it is seldom that a manufacturer is called on seriously to enlarge only one size. An 18-inch lathe raised to 20 inches actually costs as much as the standard 20-inch to build and is, of course, plainly inferior. The result of this is that the raised lathe is usually easily distinguishable from the standard tool. From the manufacturer's point of view this is a necessity, otherwise the purchasing public will think that the manufacturer is discriminating between customers.

Unintentionally a friend of mine got into difficulties because he built his 14-inch lathes to actually swing 16 inches and a little over. He found that dealers who had an order for a 16-inch lathe would order of him a 14-inch size; sell it to the customer as a 16-inch lathe and pocket the difference. When it was brought to his attention he said that he could not see how the customer was fooled. "Don't they know how to tell what size lathe they have received?" I told him that I did not suppose that one customer in a hundred knew that the size of a lathe was the distance between centers of the inside V's multiplied by two. In fact I don't believe that so ancient an idea would be held legal today.

Why any manufacturer should feel impelled to try bargain-store tactics in selling machinery, I don't know, nor why a customer should be attracted by any such scheme is beyond me. It does not even have the plausibility of lumber dealers' methods; of course, when we buy 3-inch flooring we expect to pay for stock it was made of, and get something like 2½ inches width to use. We understand that the rest is waste. The lathe builder has no such excuse.

If a customer has a lot of work which requires a swing of 24 inches for it to clear, but where the cutting is all done on a diameter of 6 or 8 inches, he is justified in asking for something other than a full 24-inch lathe. A special machine is what he wants, and no one is in so good a position to build a special machine as a lathe builder, who has patterns and tools all at hand for the work. He is the natural one to be consulted. If he refuses he may lose other orders from this customer. If he accepts the order he may lose orders from other people who see the machine and think the monstrosity is his regular pattern. The only effective loophole for escape that I have found is to accept the order and then build the machine with separate raising blocks that can be removed if wanted. At one time I carried the idea so far as to refuse to ship the lathe with the raising blocks in place, but that was rather an extreme view.

On the same principle a planer builder should put widening blocks between the posts and chucks of the bed and at the ends of the arch bar. A widened planer is a more serious proposition than a raised lathe, for with many designs it means special shafts and always a new cross rail and top shaft.

MARKING CAPACITY OF MACHINE TOOLS

The suggestion that I would like to make is that all machine tools should

have cast in some prominent place the intended capacity. For example: if the lathe is to be sold as an 18-inch machine, the figure 18 might appear on the front of the headstock, preferably in sunken letter taken out by a core, or raised letters in a cored depression so as to prevent concealment by chipping off the numbers. Any machine which is specially built could be marked in the same way, "Special," or if it is a planer the original and altered size could be given, as a 36-inch standard planer widened to 40 inches could be marked 36—40x36, thus signifying to a purchaser, if it is offered second hand, that the machine is not to be rated as a standard 40-inch planer.

Springfield, Mass. ENTROPY.

A Western Artblacksmith

The desire to make artistic blacksmith work seems to be catching. Every once in a while I hear of someone who has read the articles on the subject in the AMERICAN MACHINIST and has been seized with an irresistible longing to do likewise.

The halftone shows the work of R. D. Bromley, Geneva, Ohio, who is employed by the American Fork & Hoe Company.

The methods he uses are similar to Cran's except that Cran uses no special tools while Mr. Bromley uses a chisel to form the veins on the leaves of the roses. I give here his own description of the rest of the work:

"In making the water lily I first took eleven plain hair pins and turned a tiny loop in one end of each, then chipped off the other end a little shorter than the turned (note the one in the halftone). I then held the open ends in tongs and welded the opposite ends into a stem ⅛ inch diameter. I then opened out the loose ends at nearly right angles with the stem and shaped them over a pear-shaped core about ⅝ inch diameter. I then assembled the first 10 petals over this. The petals are so formed to fit themselves to the core and reach a little beyond it so it cannot work out. In order to hold these in place until grasped by tongs to fit and hold them, I find it necessary to slip a rubber band around the first five and then slip the others under this one by one, thus holding them each in place until properly in the tongs. I then weld up as close to the core as possible, with a hammer having rounded corners at the face to prevent cutting off the thin petals. I then assemble the next 12 in the same manner and also the 9 outside or calyxes. I then draw the stem down to 3/16 inch thick and weld on to this enough to get the long stem.

"In opening up the petals the core comes out and the flower is easily shaped with small thin-pointed pliers.

"The carnation is much more difficult, as there are so many small petals and the edges serrated or feathered with a special tool. To do this I use a hardy placed in the anvil and dull it until it is very ragged on the cutting edge and holding the piece very low down and bringing the blow of the hammer low down also it does not cut but tears off the edges, leaving a very good imitation of the natural carnation petal, but the gas from the coal during the welding process eats away the best part of this. The double calyx or outside part is made by welding the smaller part to the main piece first as shown in the cut. A longer point than required is left upon it, reaching over the main flower so that it can be held in place while being welded, then bent back and the surplus part clipped off to form the desired point. The narrow leaves attached to the stem are made very thin, of the proper width and formed with a chisel pressing them into a V-shaped tool. The smith does not know whether his work is a success or a failure until the flower is opened up and the core removed. (I use a very small core in carnations). All welding must be done first for the open flower could not be held in any tongs after that.

"The carnation in the cut is my second. The first I found had several petals out of place so much they could not be twisted back to look right.

"In making my iron flowers I have used a little spare time now and then so it is difficult to say how much time I spent on the whole. The light-colored single rose with 22 petals, 5 calyxes and spray of 5 leaves I completed in 1½ hours.

"I presume the whole time upon the whole would reach from 30 to 35 hours. I

THE WORK OF A WESTERN ARTSMITH

treated the work to an acid bath for 1½ hours to remove all scales and dirt."

Mr. Bromley finished his flowers by painting them in natural colors. I told him that I thought he had ruined them by so doing. To my mind an iron flower ought to be left about as it leaves the fire but everyone is entitled to his own opinion on the subject.

New York. E. A. DIXIE.

Toggle Riveting Pliers

The accompanying line-cuts show an extremely powerful little device recently designed by me for the purpose of riveting or expanding a small conical-pointed stud into projecting ears around the edges of a cast-brass clock cover.

As you will note by the dimensions given on the cuts these pliers are only six inches in length, yet they are capable of exerting a pressure at the moment of riveting of 1500 pounds, and for the purpose to which they are put a moderate grip of the hand is sufficient to expand the rivet in position.

Referring to Fig. 1, the two handles marked *A* and *B* respectively, are machine steel forgings, carbonized and hardened, and having the outer portion where the hand grip comes nurled to facilitate holding them. The lower jaw *C* is also of machine steel carbonized and hardened, and the link and studs are of hardened tool steel. All parts are machined all over.

Fig. 2 gives the details.

Previous to the origination of this device, these studs were riveted into position with the aid of a rivet set and a hammer, by placing the rivet in position over a spur fastened to a steel horn, which was securely clamped to a bench vise.

By the use of these pliers the cost of this operation has been reduced over 50 per cent., at the same time making an agreeable task out of what was heretofore a disagreeable one.

Of course the toggle construction is the secret of the great power in this device, and when the angle between the toggle and centers, and the toggle junction center is two degrees, a grip of 25 pounds applied to the handle 4¼ inches from the fulcrum point of the handles, will produce a pressure between the riveting points of 2750 pounds, disregarding friction losses, which are naturally high in a mechanism of this description and which in this particular case approximate 40 per cent.

Dayton, O. CLARENCE CARSON.

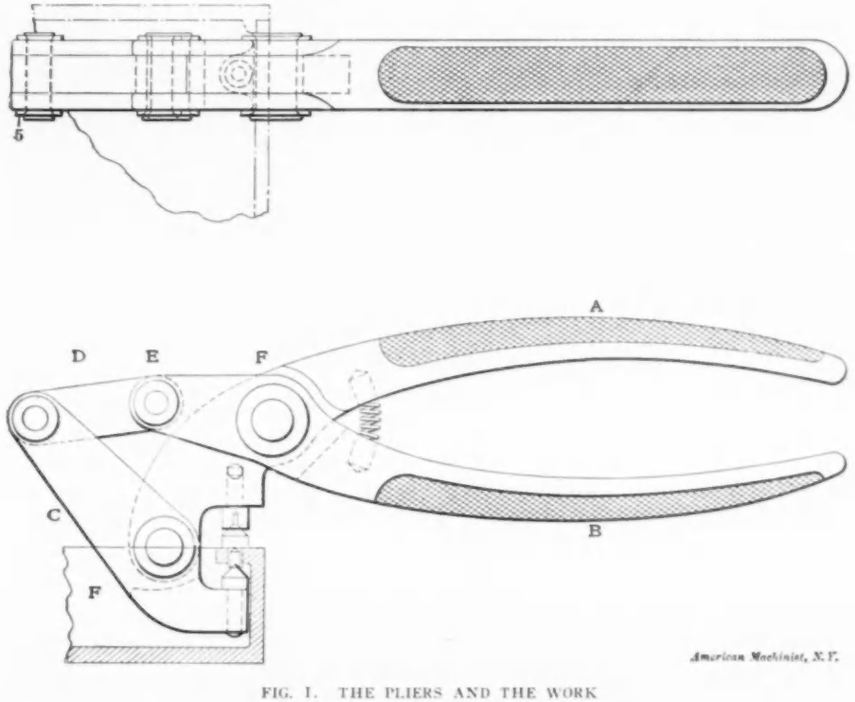


FIG. 1. THE PLIERS AND THE WORK

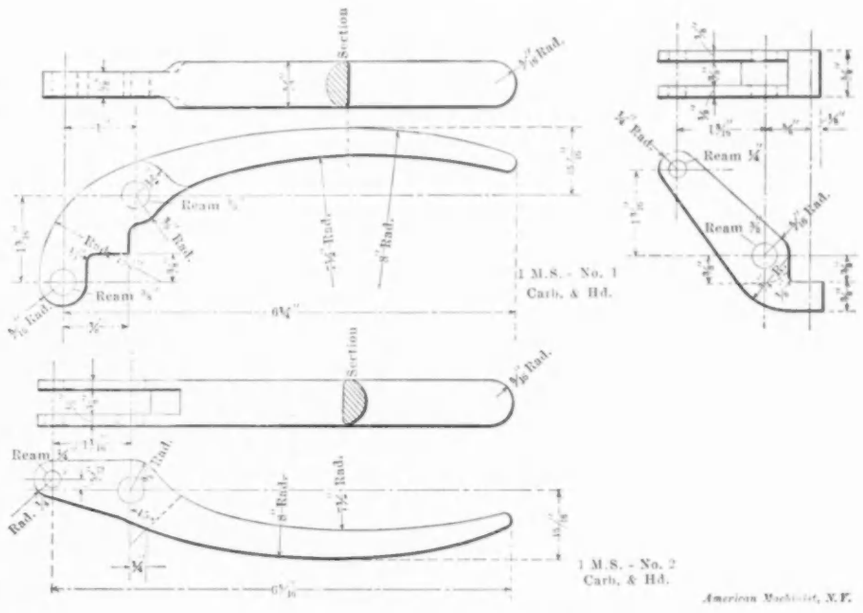
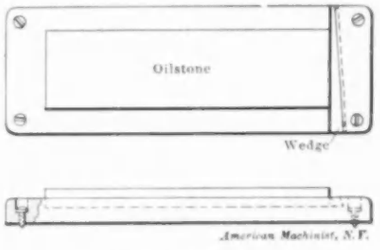


FIG. 2. DETAILS OF CONSTRUCTION

Simple Effective Oilstone Holder

The construction of this holder can be seen clearly from the drawing. It should be made of hard wood to prevent splitting when wedging the oilstone in. It is a great protection against breakage and a broken oilstone can be wedged together in this box, for I made mine to save a broken one which it did satisfactorily.



AN OILSTONE HOLDER

The four screws with sharp points, one in each corner, are to prevent the oilstone from sliding along the bench when the stone is in use. They can be screwed up into the wood, if not wanted, without projecting above the upper surface of the wood.

One corner on the drawing shows a section through the center of the screw for clearness.

A. NIELSEN.

Cleveland, O.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Inventing and Patenting

"Reduction to practice must produce something of practical use, coupled with a knowledge, preferably by actual trial, that the thing will work practically for the intended purpose. The conception may give rational hopes of future fulfilment of the purpose at which it aims; but if as a matter of practice it falls short of success it is not a sufficient reduction to practice. Complete invention amounts to demonstration. When, as in this case, it had not quite passed beyond experiment and had not quite attained certainty and had fallen short of demonstrating the capacity of the invention to produce the desired result, the invention itself was still inchoate. The parties sought certainty, but they had not attained certainty beyond conjecture, which certainty the law required."

The Court of Appeals in Sherwood v. Drewsen (130. O. G. 657; 29 App. D. C. 161) said the above.

It sounds fair, but is a patent a "square deal?"

Three questions: What is a patent? What is it worth? What protection does it give?

Answer to No. 1; A piece of paper describing an invention under the seal of the United States Patent Office.

Answer to No. 2; It is worth, if a commercial article and in great demand, its original cost plus what it cost in law suits.

Answer to No. 3; None, unless the inventor or owner has unlimited capital and more than the party who wishes to infringe or steal the patent.

Take the case of A and B: Application of B filed Sept. 11, 1906, No. .....; application of A filed Aug. 7, 1906, No. ..... B had a patented machine for doing certain work. A invented a machine for doing or accomplishing the same work in a radically different and more efficient manner.

As soon as A had filed his application he attempted to put his machine on the market. B sees that if a better machine than his is put on the market his "hash is cooked." What does he do? He starts suit for injunction restraining A. The injunction is not granted, but B writes to all the trade that he is suing A and he will hold them responsible if they use A's machine. B also files an application for a machine embodying the principles of the machine invented by A, which, as A was trying to sell to the trade, B could naturally see or get a good description of.

The result is an interference suit. After over two years "Priority of invention is awarded to A, the senior party." "Limit of Appeal, Dec. 24, 1908." Dated Dec. 4, 1908. Signed....., Examiner of Interference.

Appeal No.....

U. S. Patent Office July 30, 1909.

Before the Examiners-in Chief, on Appeal.

"The decision of the examiner of interferences, is hereby affirmed."

Limit of Appeal Aug. 19, 1908

(Signed).....

(signed).....Examiners-in-chief.

(signed).....

.....

This has at date of writing (August 11, 1909) been appealed.

This appeal is to the commissioner and from his decision there is an appeal allowed to the Court of Appeals which is final so far as the Patent Office is concerned. When I say final it does not mean that B cannot start suit on some other point. If B carries his case to the Court of Appeals it means more than likely another 20 months.

In both the above decisions is found the following: "A has taken no testimony. He is, therefore, restricted to his record date, August 7, 1906, as evidence of conception and reduction to practice. B has taken testimony in support of the allegations made in his preliminary statement. The allegations are as follows: Conception .....1892, drawings ..... Aug. 1, 1896, disclosure .....1892, reduction to practice .....1894."

On the last page of the decision of the examiner of interference is found the following: "B was in full possession of the facts and being a prior patentee knew what was necessary in the filing of an application. B admits that he only filed his application when he had obtained knowledge of the entry of his opponent into the field. This urged him on but it appears it was too late."

"The risk that a rival may appear at any time is something which every inventor is bound to contemplate and anticipate and in this lies the fundamental reason for the requirement of due diligence." (Platt W. Shipley Supra.)

"As long as B felt himself alone in the field, he was content and satisfied with his patented machines. When he felt that a rival was liable to interfere by obtaining a patent for which he, B, believed he had conceived at an earlier date, he was not slow to assert his rights and accomplish what he had merely been attempting before, namely to convince and persuade his attorney to file an application. If he could procure the filing of his application under these circumstances, there is no reason why he should not have done so earlier. Under all circumstances of this case it is considered that B was not diligent in filing his application."

To anyone reading the above decision there is, to my mind, but one meaning, if B really conceived the idea at the date he claims and B further claims that he could not make the machine operate perfectly nor could he turn out perfect work, that is that B in order to produce a perfect machine had to see the machine as invented by A.

What I am trying to make clear is, in 9 out of 10 cases by the time a patent is issued an inventor, unless he has unlimited means, has not enough money left to push his patent. Take the case of A and B, B has had the cream of the trade and A will get the leavings as the invention by the time a patent has been secured will have outlived its usefulness. If a patent cost $1000 in government fees exclusive of attorney's fees it would be cheap if it guaranteed absolute protection. Even after a man has a patent he must protect it against all comers. If the patent office cannot give absolute protection, it should at least not allow a man to bring suit unless he had a *bona-fide* case. At present a patent even if adjudicated, does little more than establish the date of application and the date of the issue.

Another thing that makes it hard for the real inventor is the number of patents granted for things which are in reality not inventions at all and have no commercial value. Take for instance the mechanical draftsman, in the course of his career he overcomes mechanical difficulties which are real inventions but to him they are nothing but mechanical movements.

The patent fiend is really the untrained, unmechanical man who sees improvements in everything, but in reality they are nothing more than such things as the ordinary mechanic overcomes every day. Another question arises, an untrained man comes to the mechanically trained man and says, "If I had a machine which would do certain work I would have a good thing." The mechanically trained man *designs* the machine and *accomplishes* the results. Who is the inventor? Who makes the money if the patent is a money maker?

Still another fact unfair to the general

public is the throttling of improvements by railroad, telegraph, telephone and large companies generally. If an invention is brought out for an improvement for some article in great demand, it is generally bought up by the manufacturer and forgotten unless it will help him to down a competitor. Take for instance a railroad which has some safety device, which it uses in very large quantities, the parts of which must naturally be renewed from time to time, it will make no changes unless forced to by law or in fights with a rival road. The reason is plain, it cannot equip part of the road with one device and part with another. All parts must be interchangeable. If the road has no competition all well and good, but if there is a rival it buys up the patent for the improvement and shelves it. It would seem but fair that a patent shelved for a certain period should become public property. Another case of shelving is by some inventors who get out a certain thing and then patent everything in sight, not with any intention of using but to have competition stopped if possible.

New York City. HERMAN JOHNSON.

I have just read the article by L. P. Alford, on page 221, entitled "Inventing and Patenting." While as a whole the article appears impressive, it does not contribute as much as it purports to the readers of your journal for the following reasons:

In its title it is misleading. One of its headlines states: "Average cost of a patent, $570, not $65," but the text discusses question 1, which relates to the cost of *invention and* patent. It should be remembered that a patent is collateral to its invention and not *vice versa*.

In column one of the text the parenthetical statement is made: "(Patent solicitors' advertisements and pamphlets have created an impression that a patent costs about $65.)" This is also believed to be incorrect as a statement based on the premises presented including "the patentee's time, worry and labor."

For some years I maintained a collection of patent attorneys' circulars, booklets, etc., but recently destroyed them as they appeared to serve no good purpose. Many, if not all, quoted a price of about $65 for a patent, but expressly stipulated that this applied only to simple inventions requiring only one sheet of drawings, and that complex cases would be charged for according to the work involved. In none of them do I recollect a suggestion that the cost of developing, perfecting and patenting could be compassed by $65. Further, I do not recollect any implication that could by a stretch of the imagination lead a confirmed romanticist to such a conclusion.

It is not my intention to defend the questionable and nefarious methods of the patent shark, with which I have had some experience, but the assertion made, and to which reference is had, belittles the victim and extols the commercial skill of the solicitor, for it attributes to him ability to make people believe his assertions irrespective of their plausibility, and that is the soul of salesmanship. To me it is doubtful, and indeed inconceivable, that any of your readers can have imagined that the solicitors' $65 covered the items covered by Mr. Alford's $570, and just so far as they do not, the article loses force.

The average cost of obtaining a United States patent probably does not run above $150 with a good attorney, and it is doubtful if it exceeds $100.

For several years I personally had charge of a patent department for a large corporation. The cost of drawings was abnormal as compared with usual practice because we insisted upon artistic excellence as well as mechanical accuracy. We made up the applications complete, and drafted all responses to the examiner's communications. Those were all reviewed and filed by a firm of patent attorneys in Washington. Without access to the concern's books, but by conference with an associate in the work who is now in charge, the average cost of these United States patents is believed to be only about $250 under the conditions named, and including all patent charges.

The primary question is one of inventing. Secondary and subordinate is the question of expediency of securing a title to the same through a patent. Whether or not invention is profitable depends on the value at which improvement and progress are held. This may be said to beg the question presented by Mr. Alford's article, but reverse the proposition and see the result. Is it profitable to cease inventing because one does not either immediately or eventually secure the large and unusual reward secured by some others? In short, is it profitable to discourage invention because everyone does not receive the plum, and most of those who try attain "a lemon?" Lack of attainment marks the roads to all lines of success. For the men who gained fortunes in California in '49, and those who have done likewise in Alaska and elsewhere, how many more have failed? Reference has been made to "barons of manufacture," but how many a tale can they tell concerning inventions financed that have been merely punctures of the exchequer?

Do we condemn real estate investments because someone with lack of gumption purchases a house lot in an unreclaimable swamp, or a cranberry bog on top of a gravel bank? If people will invent things of which they know nothing, they are to be pitied if not amenable to censure.

Truly, as Mr. Alford says, "laziness and necessity are the parents" of many pseudo inventions; and pseudo inventors are as much a source of worry and annoyance to the real inventor, as are predatory corporations. The real inventor is naturally resourceful and usually conceives several means to the same end. It is usually impracticable if not impossible to develop the invention along many lines concurrently, so the least promising treatments are laid aside and the most advantageous are adopted. As soon as the device is reduced to practice one or more pseudo inventors loom up with one or more of the constructions that have been laid aside, perhaps for future consideration, and claim attention and emolument for *their* improvements. There is a multitude of such, too lazy to imitate, but ready to "circumvent" any new article or device and hold up the real inventor; veritable Arabs, demanding "backsheesh." In my experience these are they who are loudest in their lamentations about "lack of recognition," "technicalities," etc. For such I have no pity.

There are others to whom invention is purely a matter of speculation. If they did not invent their money would go via some other channel in the "get-rich-quick" category that includes the sure-thing mail-order business and the raising of ginseng.

Invention should be stimulated and not repressed, and the best stimulation can be derived from a closer scrutiny of the problem and its sane consideration. There is room for a series of articles extending over several issues, supplemented by further "experiences" which should surely lead to a more rational contemplation of the subject than is now indulged in by the popular mind. This has been written hurriedly as time permitted, and if it unduly disparages Mr. Alford's contribution, he has my sincere apology. If it opens up a comprehensive discussion much will be gained.

Central Falls, R. I. E. C. SMITH.

Cutting a Worm Gear without a Hob

Following the letter of E. S. C. at page 418 is an editorial comment, stating that in order to get the same shape of teeth as a hob would make, the cutter arbor would have to be fed longitudinally past the work, and the suggestion was offered that this result could be accomplished by connecting the large gear to the cutter arbor by means of a feather, and then feeding the dividing head toward or away from the column. If this was done, the teeth on the worm gear would all be milled away, and nothing left except the "bottom diameter," as will be apparent on a little consideration; that is, if the feather was made as we ordinarily understand the term—parallel with the arbor. But by using a *spiral* feather, of the same lead and same hand as the worm with which the worm gear was to mesh, then the result aimed at by the editor might be accomplished, but this would probably require as much work as to make a hob, if not more.

Brooklyn, N. Y. WALTER GRIBBEN.

Why are Pyrometers Discarded?

On page 339 of the AMERICAN MACHINIST, "Coram" answers C. U. Scott's question, "Why is the pyrometer discarded in so many shops?" Mr. Scott thinks the fault lies in the selection and that because the proper equipment is not selected, it fails to do the work and is thrown out.

"Coram" partially agrees with this but thinks they are also discarded because they generally (even when carefully selected) fail to do what is expected in that they do not indicate the temperature of the work—particularly if it is large; they vary and are not permanent when once adjusted; they need careful and constant attention of men of laboratory experience and finally they are limited in successful use to only certain classes of work.

All that "Coram" says is true, but these things are serious only because the simplest method of using, testing and checking pyrometers is not generally known. For instance: In the matter of checking the instruments "Coram" suggests the observation of the melting points of certain salts, the melting point of which has been guaranteed by a responsible chemist. But Mr. Coram does not tell us of an easy way in which to observe these melting points without taking considerable time and going to considerable expense and trouble.

There are on the market today a couple of makes of "Segers" cones or little pyramids made up of various salts or chemical compounds. These cones or pyramids, which are from 1½ to 2 in. high, are made to melt at any given temperature and are numbered so that there can be no possible mistake as to the identity of any particular pyramid.

These cones or pyramids are made for use in all of the various processes of manufacturing, but to make clear the way in which they are used one illustration will suffice. Take for example the pyrometer in an oven furnace used for tempering various high-speed tools. These tools in various makes of steel will require from 1800 to 2300 degrees Fahrenheit. These requirements must be explained to the pyrometer manufacturer when the instrument is purchased and any reliable maker of pyrometric instruments can select the proper one.

To properly check the above instrument, it is not enough to be sure of it at 2000 degrees Fahrenheit, and trust to luck that the higher and lower readings are correct. It should be tested over the entire working range. To do this select two each of the cones made to melt at 1800, 1900, 2000, 2100, 2200 and 2300 degrees Fahrenheit. To facilitate observation they should be placed on a flat piece of firebrick in the position shown in the cut. A thin layer of soft fireclay will make them stand vertically and prevent their falling over when the brick is moved.

This brick and the cones are placed in the furnace with the cones of lowest melting point nearest the front or door of the oven. It is needless to say to the careful workman that a direct flame must not strike a cone unless the temperature of the flame is to be measured. As the furnace heats up slowly, the cones are heated to the same temperature, and when that part of the furnace reaches 1800 degrees Fahrenheit, the front cones will begin to melt and flatten out. As soon as the melting starts the pyrometer reading should be noted and any difference recorded. The two 1800-degree cones should go down at once, thus checking each other. As the heat increases the next pair will go down and the reading is noted, and so on until the last has melted.

If the pyrometer indicated these melting and softening points accurately, it may be relied upon, but should be checked up in the same way whenever time permits. Of course, we are now speaking of the commercial use and checking of instruments. The cone method would not do for exact laboratory practice where a variation of a degree or fraction of a degree is noted.

For tool work, checking with these cones has another distinct value which removes one objection raised by Mr. Coram. They are placed in the furnace or oven in the same place as the tools or work in question and, of course, indicate the temperature at that point. The pyrometer fire end (if electric) may be in the roof or at the end of the heating space, but if its readings check with the melting of the cones, it means that the pyrometer indicates the heat of the work. If it does not check, it means that a given number of degrees must be added to or deducted from the pyrometer indications to make the temperature agree with the heat of the work or tools. This "error" may be deducted mentally or the manufacturer can adjust the instrument to offset it, if he knows the exact number of degrees of variation.

To summarize: This "cone" method of checking simplifies pyrometer use by making checking easy and accurate; reducing the cost of checking, as the cones cost only 2 to 4 cents each; making the pyrometer show the heat of the work, and thus making it do what it is bought for.

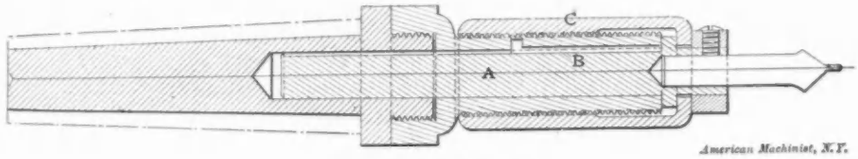
I have the greatest respect and admiration for the skill of the furnace man in any line of work who can judge heats by the "color," trusting solely to his trained eye, but the fact that a few can do this should not lead to the abandonment of scientific instruments in heat treatments which are so vital to the successful use of most of the finer steels.

Chicago, Ill. M. DOGECLA.

Sensitive Centering Tool

There seems to be some dispute as to the priority of a method of giving a longitudinal motion to a shaft inside a revolving sleeve.

The accompanying sketch shows a centering tool which was made about fifteen years ago and on which I applied for a patent. The taper shank fits into the lathe spindle, this drives the central spindle *A* by means of the key *B*, the center drill being fastened in *A*, and driven with it. The sleeve *C* has a fine left-handed thread and controls the movement of the center drill by means of the collars shown. The drill is driven by the live spindle of the lathe and is fed into the work by retarding the revolution of the sleeve *C* with the hand, this feeding the spindle containing the drill out of the main socket. This is particularly useful in centering large work.



A LATHE CENTERING TOOL

Chicago, Ill. M. JACKER.

Filing the American Machinist

Reading the article on page 375, G. H. Gibbs, of Loughborough, Eng., leads me to tell how I file my AMERICAN MACHINIST. I remove the advertising matter, then file each copy in an office pasteboard letter file, which can be bought for 20 cents from any stationer dealing in office supplies. One file will hold six months' copies, with index in nice shape and without overcrowding. The files have indexed leaves secured in place, which make it convenient to insert or withdraw single copies without disturbing the whole volume. On the back of the file I paste the volume number, date, etc.

This, I think, makes a convenient and not expensive method of filing. Any article can be gotten at, removed, read and replaced about as easily as can be desired.

In regard to what the AMERICAN MACHINIST has helped me to do in the way of bettering my position: I have had ten advances of $1.50 per week each, also less manual, but perhaps a little more head work, all within a very few years, which is not so bad for a common machinist. In all my work the AMERICAN MACHINIST has very materially helped me.

Buffalo, N. Y. F. E. A.

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September 9	19,250
September 16	19,250
September 23	19,250
September 30	19,250

This paper reaches 34,750 *separate readers each month and* 19,250 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

Contents

	PAGE
Telling Time by Automatic Machinery	557
Why the Cutters Gave Cause for Trouble	563
Aëroplane Records	564
Adopting the Metric System	565
Design of a Chuck Key	565
Six Alsatian Machine Tools of Recent Design	566
Echoes from the Oil Country—Mechanics Being Made	569
Factors for Proportioning Spur Gears	571
A Snap Washer	576
An Improved Spring Threading Tool Holder	576
Some Notes on Tests for Hardness	577
Court of Patent Appeal	580
Professor Sweet's Equal Wearing Surfaces	582
Practical Letters from Our Readers: A Thread Milling Scheme....Indicating Capacity of Machine Tools....A Western Artsmith....Toggle Riveting Pliers....Simple Effective Oilstone Holder	583-585
Discussion of the Previous Question: Inventing and Patenting....Cutting a Worm Gear Without a Hob.... Why are Pyrometers Discarded.... Sensitive Centering Tool	586-588
Progressive Japan and American Conceit	589
Wages, Hours and Costs of Work	589
New Tools and Machine Shop Appliances	591

Progressive Japan and American Conceit

German industrial success is frequently commented on in this country, and at times with an unconcealed element of bitterness. A far saner spirit is, of course, one that recognizes the points of superiority and endeavors to emulate them.

It is more than likely that in a few years there will be another powerful industrial nation to deal with, this time in the West. Japan is buying the best of our machinery in all lines and is keeping in close touch with our every move of progress.

A recent incident shows the truth of this statement. A few months ago we published an article in regard to the equipment of one of our leading ship yards. One machine illustrated was special in character and designed and built by the ship company for their own particular needs. Specifications just received in this country for a number of machines for a Japanese ship yard specify two machines like the one illustrated in our article, and refer to our article as a source of information for the American bidders.

We are naturally pleased at this proof of the close, intelligent scrutiny with which our pages are read in Japan, but the important fact to note is that Japanese engineers, manufacturers and mechanics are taking our best in the way of machinery and methods and making it the great stepping stone of their own progress.

It may not be a palatable criticism of the American attitude, but our manufacturers are too prone to throw out the chest and conceitedly declare that "we are the people." Such an attitude is worse than absurd, it is nearly suicidal.

Many foreign countries, Germany and Japan in particular, have experts in America all the time studying our industrial ways and results. Some of these experts are paid by the government, and many others are in the employ of manufacturing firms and commercial houses. It is safe to say that no important development takes place here that is not known at once there.

How many American experts are abroad keeping in touch with the trend of foreign development to the benefit of our industries?

If anyone wishes citations of foreign preëminence, look at the chemical industry of Germany. Raw materials are imported from America and manufactured into chemical products to be exported to us. If a development nearer machine tools is wanted as an example, consider the hobbing process for spur gears. Several hobbing machines are built in this country, but opinion is by no means fixed as to the success of hobbed spur gears. On the other hand, this process has been brought to a high degree of perfection in Germany and at least one German hobber is imported in considerable numbers here. Apparently they believe fully in hobbed spur gears.

Many times it is wise to "find out what the other fellow has done."

Wages, Hours and the Cost of Work

In too many cases we are apt to overlook the fact that the rate per hour or per day does not determine the cost of the work per piece, and we estimate a piece of work on the basis of "a dollar and a half man" instead of considering the effect of putting a better man on the job. Or, in comparing the cost of two jobs we find that one man took eight hours and another ten hours and overlook the difference in wages per hour.

It is quite probable that there are many cases similar to the one recently observed in a job shop, as follows: A certain lot of work came in which had always been done by a low-priced man, being considered a cheap job. No man of this kind being available the foreman was obliged to give it to a high-priced man as no delay was possible. To his surprise, the high-priced man did the job at a lower cost per piece than the cheap man had ever done it, and in future this will be handled by the high-priced man, in spite of its being a so-called cheap job. This is one of the cases that is difficult to decide and has made the foreman wonder whether cheap help pays at any job.

In comparing the cost per piece as made by the two men he hit upon the plan, not new in any sense, but one that could be used to advantage in many places, of reducing all work to a uniform rate per hour as a basis.

Taking twenty-five cents an hour as a base he figures out that eight hours for a man getting two and a half dollars per day is equivalent to ten hours for the two-dollar man and thirteen and one-third hours for the one-fifty man. Then if the twenty-five cents an hour man does a job in ten hours that takes the twenty-cent man fifteen hours, he deducts one-fifth from the fifteen hours and finds the comparison is as ten and twelve.

This reduction to the twenty-five cent an hour basis is done by the time keeper in making out the time slips so foreman need not consider the money end of it in the least, but simply the hours worked. This has the advantage of not only comparing the cost in hours, but also of showing the time which the machines used will be tied up as, even at the same labor cost, the extra use of the machine which is secured when the faster man uses it, may amount to considerable, especially in a rush season, and in the case of a large and expensive machine.

This gives a method of comparing the

real efficiency of the different grades of men and of showing when a man is worth more money, as well as any way we know of.

The Avery Steam Turbine

We learn from the *Journal* of the American Society of Mechanical Engineers that Prof. John E. Sweet, past president and honorable member American Society of Mechanical Engineers, and a nephew of William Avery, the inventor, has presented to the society the rotor of one of the original engines built in Mr. Avery's shop in Syracuse, N. Y., sometime between 1835 and 1840. The Avery engine was a turbine of the reaction type, having a hollow forged rotor in the form of two diametrically opposite arms. The arms were hung on a hollow shaft through which the steam entered, passing through the hollow arms and escaping through orifices at their ends.

In a description of the engine Professor Sweet states that the shaft had no metal bearings except at the extreme outer end and beyond the driving pulley; at the end of the shaft opposite the steam pipe, where the steam entered the hollow shaft, rollers were placed to take the pressure of the steam, usually 150 pounds. The metal bearing referred to was in connection with these rollers. On each side of the case in which the arms revolved was a packing box in which hemp packing was used. These two packing boxes made the main bearings of the engine.

A Mr. Herrick, who helped build and operate the engines, said that when slide-valve engines were substituted for Avery engines no gain was made in steam economy. Trouble was had with the packing and with the cutting out of the blades at the ends of the arms. Mr. Avery refers in his notebook to a rotor 7 feet long which ran 14¼ miles a minute.

The rotor is a most interesting relic of what was until recently a forgotten piece of the early history of the steam turbine and its gift to the society insures its preservation.

New Publications

INVENTIONS, PATENTS AND DESIGNS, WITH NOTES AND THE FULL TEXT OF THE NEW BRITISH PATENTS AND DESIGNS ACT, 1907. By G. Croydon Marks, M. P. 116 pages, 5x7¼ inches. The Technical Publishing Company, Ltd., London. D. Van Nostrand Company, New York. Cloth; price, $1 net.

Vital American interest in the late British patent act, which provides, among other things for the compulsory working of inventions, ought to create a call for such a handbook as this throughout manufacturing circles. It is self-evident that, as the author points out in his preface, inventions are of international rather than national growth. Reciprocity of improvements, therefore, creates a unity of mechanical progress which is something more than mere comity and favors a legal mutuality. It would be well for everyone who anticipates applying for a British patent to obtain a general idea of the methods he must employ, and this the present book seems well calculated to give him. It is by no means an "every-man-his-own-patent-attorney" misguide, and will not obviate the need for professional assistance in drawing the application, or in forming an opinion upon delicate questions, but will supply that general grasp of the situation which is desirable by the intelligent client.

The first 58 pages are occupied with notes on the elementary principles of British patent law and procedure. Incidentally we find, at page 37, a reference to the drastic provision in the new law whereby an unfair condition in a license is a ground for avoiding a patent, so that an infringer by attacking one license which is illegal, may impair the rights of other licensees whose agreements are entirely correct. For protection of the latter, extreme care is needed in drawing up licenses, and the author suggests a safeguard that may be resorted to.

The brief remarks on working patents in England will be among those most attentively perused. Of interest also are annotations on the reliability that may be incurred by threatening legal proceedings and sending out deprecatory circulars, letters, warning notices, etc.

Not least important is the text of the patents and designs act of 1907, here published in full.

Personals*

F. H. Banbury, engineer of the Acheson Oildag Company, Niagara Falls, N. Y., sailed for Europe on September 25, for an extended trip in the interests of his company's patents.

A. M. Jellison, until recently employed in the motor-production department at the General Electric Company's Lynn works, is now connected with the fan-motor production at the Pittsfield works.

J. A. Emmons, for the past eight years foreman of the winding department of the Western Electric Company, Chicago, Ill., has resigned to accept a similar position with the Automatic Electric Company, Chicago, Ill.

Fred H. Vose, until recently assistant professor of mechanical engineering at the Washington University, St. Louis, Mo., has joined the mechanical engineering department of the Case School of Applied Science, Cleveland, Ohio.

Charles B. Dudley, a chemist in the employ of the Pennsylvania Railroad Company, has been elected president of the International Association for Testing Materials, which will hold its next congress in New York in 1912.

Prof. G. F. Swain, professor of civil engineering, Massachusetts Institute of Technology, and member of the Massachusetts Railroad Commission, has become professor of civil engineering at the graduate school of applied science, Harvard University, Cambridge, Mass.

J. A. Eden, Jr., for some time connected with the forging-machinery department of the E. W. Bliss Company, Brooklyn, N. Y., recently resigned to accept a position as manager of a similar department for the United Engineering and Foundry Company, of Pittsburg, Penn.

T. C. Martin, for a number of years editor of the *Electrical World*, relinquishes his position on October 1 in order to become general secretary of the National Electric Light Association, an organization in which he has taken an active interest since its inception, Mr. Martin, in fact, being its chief founder.

*Items for this column are solicited.

Fire Losses and Conservation

Fire is by far the most destructive agent to our forests. The loss to the forests from this single cause is colossal, and if we add the loss of buildings burned in our cities and villages, it becomes still more so. The direct damage from the 1908 summer's forest fires has been estimated at, approximately, $100,000,000, but the injury to the water sheds and all the damage which follows deforestation cannot easily be computed. Between 1877 and 1907 forest fires caused a loss of 1956 lives, besides millions of acres and forests. The annual loss of new growth, due to the destruction of seedlings and young trees by fire has been estimated at $90,000,000. The saddest feature of it all is that almost all of this enormous loss was directly avoidable by ordinary care and intelligence. Forest fires could almost wholly be avoided at a cost of one-fifth the value of the timber annually destroyed. In an interesting paper presented before the American Chemical Society dealing with chemistry as applied to conservation of natural resources, it is noted that in the last five years the total fire losses in buildings in the United States amounted to a billion and a quarter of dollars. This was due mainly to the combustibility of the timber construction employed and might have been largely prevented by the use of suitable chemical fireproofing compounds. In 1906 we spent $650,000,000 in building operations and the total cost of our fires was $500,000,000 and 6000 lives. In all the United States there are about 12,000,000 buildings, in only about 8000 of which has there been any serious attempt at fire prevention. The latest Government reports show that in 49 of our leading cities, 59 per cent. of the new buildings were of wood.

New Tools and Machine Shop Appliances

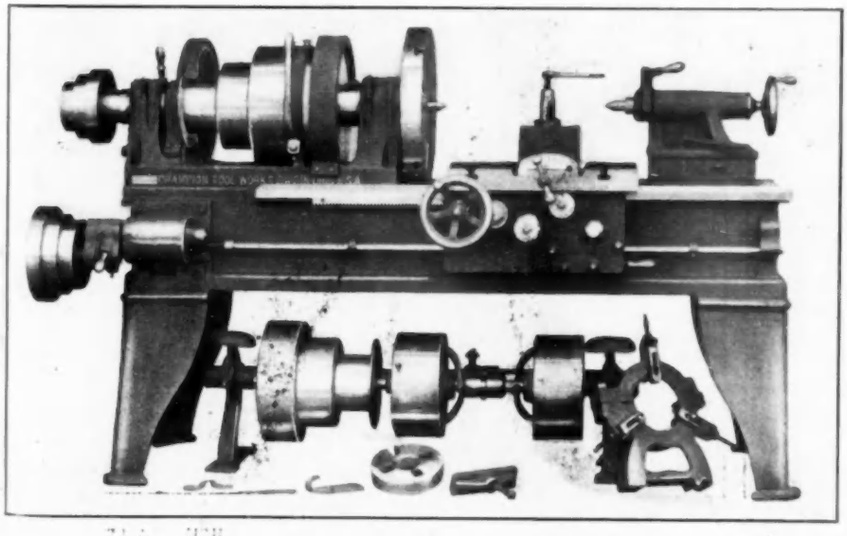
Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Heavy Plain Turning Lathe

The lathe shown has been built in response to a growing demand for the lathe which shall be capable of doing plain turning in an economical way, and for this reason it has only such parts as are necessary for this work, the lead screw and its attendant gearing being entirely absent. As can be seen, it has a very substantial headstock with a three-stepped cone for a 4-inch belt and is equipped with friction back gears. The spindle bearings are 3 7/16x5⅜ inches in front and 2⅞x4¼ inches at the rear, while the back-gear ratio is 12 to 1.

The long headstock cuts down the capacity between centers to 24 inches on a 6-foot lathe, but this makes it possible to secure the heavy headstock and the powerful drive necessary for this work. The frictions are of the toggle type and have expansion rings 12¾ inches in diameter by 2⅛ inches face, which insures power and long life, as well as allowing changes to be made from back gear to open belt without stopping the lathe. The speed cones are very large and carry a 1½-inch belt, insuring sufficient power for the feed. The lower cone is journaled in a swinging frame which acts as a belt tightener and prevents slipping. There is also a throw-out clutch on the feed rod inside the box for disconnecting the speed of the tool while running in either direction when the stops shown on the feed rod are engaged by pins at either end of the apron. The speed can be reversed in the apron by the handle shown in the lower right-hand corner. A heavy plain tool block is provided, having a power cross feed and a tool post which will carry ⅝x1¼-inch tools. This is built by the Champion Tool Works, Cincinnati, Ohio.



PLAIN TURNING LATHE WITH FRICTION RACK GEARS

The Gorton Cold Saw

This machine reverses some of the usual principles of design in cutting-off machines, and instead of transmitting power to the saw by a central shaft, makes an internal saw and attaches it to a large gear wheel, so as to get the maximum driving power and efficiency. This is designed to handle round stock up to 6 inches and squares up to 5½ inches, although 8-inch round bars can be cut by feeding the additional 2 inches by hand, and it is claimed that even under these conditions the cutting-off time is less than by any other method.

The saw, being mounted by its outer edge, is very securely fastened and driven, and has very little tendency to deflect under severe cuts. The inserted cutters are few in number, and while these may become dull more quickly than where larger numbers are used, they are very easily replaced and firmly held in position. The cutter blade is centered on 10 steel studs and secured by 10 special screws. Three thicknesses of blades are carried in stock, ¼, ⅜ and 7/16 inch, according to the work to be done, the kerf being from 1/16 to ⅛ inch wider than the thickness of the blades. The large driving gear is 60 inches in diameter, and it will be noted that the beds and driving mechanism are very massive, so as to absorb all vibration. As an evidence of this, the base is a one-piece casting of over 5000 pounds, while the lower cutter drum slide, also in one piece, weighs 2400 pounds. The driving

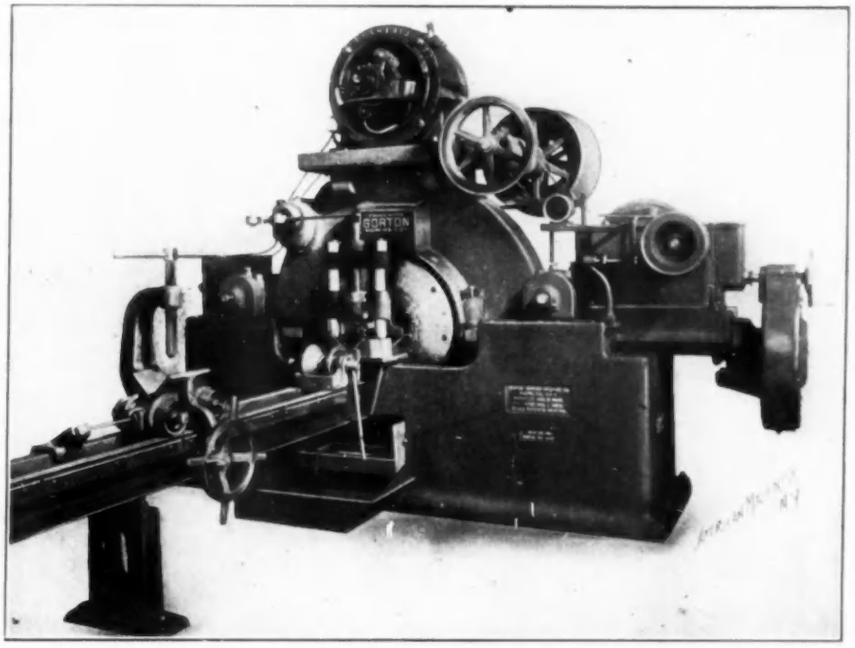


FIG. 1. THE GORTON CUTTING OFF SAW

gears have 3½ inches face and are driven through a clutch having an expansion ring 14 inches in diameter with a 3-inch face, which is at all times thoroughly lubricated on its friction face. For belt driving, the main pulley is 30 inches in diameter, and driven by a 6-inch belt, so as to give a cutting speed of 75 feet per minute to the saw. For motor drives this can be connected with either a belt or chain.

Seven rates of feed are provided, varying from 6 inches per minute to 1 inch in four minutes, and this range may be changed by changing a single-belt pulley. This has been found preferable to the all-gear drive used on the first machines of this type when all the conditions are considered. The vise will clamp from 1½- to 8-inch round stock, and allows a pressure of 25,000 pounds being put on the bar should occasion demand, a rigid holding of the work being necessary for fast work. The carriage shown has a measuring device, so that any desired length may be cut off. The stock-handling track ordinarily furnished is 22 feet long and consists of two 7-inch channels, supported as shown. Special tracks up to 42 feet long are supplied when desired.

The cutter lubricant is handled by a geared pump, shown on the upper gear case, and will deliver a stream 4 inches wide and ¼ inch thick directly into the saw, this lubrication being necessary to secure the best results at the high speeds and feeds at which work is handled in this machine.

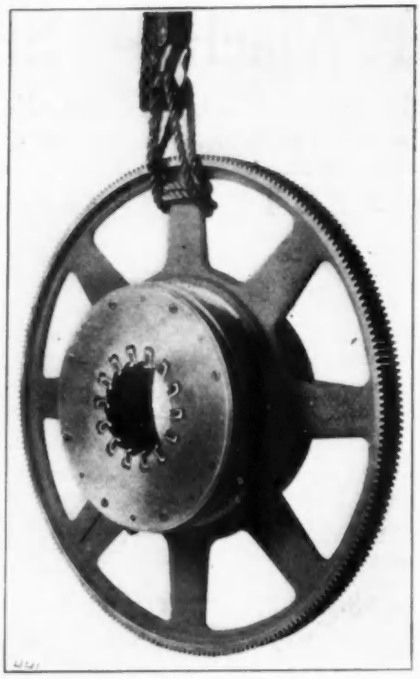


FIG. 2. THE 60-INCH DRIVING GEAR AND SAW

Lubricating details have received special attention. The cutter bearings are flooded with oil at all times, this oil being filtered through a felt pad, which should be removed and cleaned as often as necessary. All mechanism in the upper front gear case operates entirely below the surface of the oil, insuring constant lubrication. These machines are built particularly for rolling mills, car and locomotive work, and similar large shops where there is a large amount of material to be cut off in the shortest possible time. The builders are the George Gorton Machine Company, Racine, Wis.

Sensitive Radial Drills

Figs. 1 and 2 show two special designs of the high-speed sensitive radial drill made by the American Tool Works Company, Cincinnati, O. Fig. 1 is a motor-driven drill, with tapping attachments and having a 2-foot arm. The motor is entirely out of the way under the box table, and direct connected to the tapping attachment shaft, by a belt. The motor is of the Lincoln variable-speed type, running from 525 to 1575 revolutions per minute.

The tapping is controlled by the small bell-crank lever shown at the base of the column, and conveniently located for the operator. Patented frictions are used in the tapping attachment, which cannot become disengaged of themselves.

Fig. 2 shows the machine mounted on a column and without table of any kind. This is designed for work such as that shown, where automobile parts or gas-engine cylinders can be handled more conveniently on a truck, either with or without jigs, and after being drilled is all ready to be taken to the next department

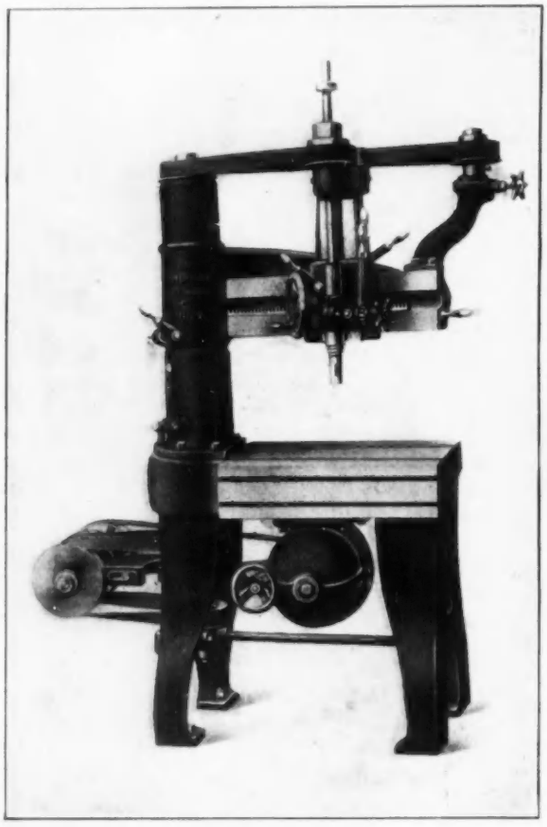


FIG. 1. SENSITIVE RADIAL DRILL WITH 2-FOOT ARM

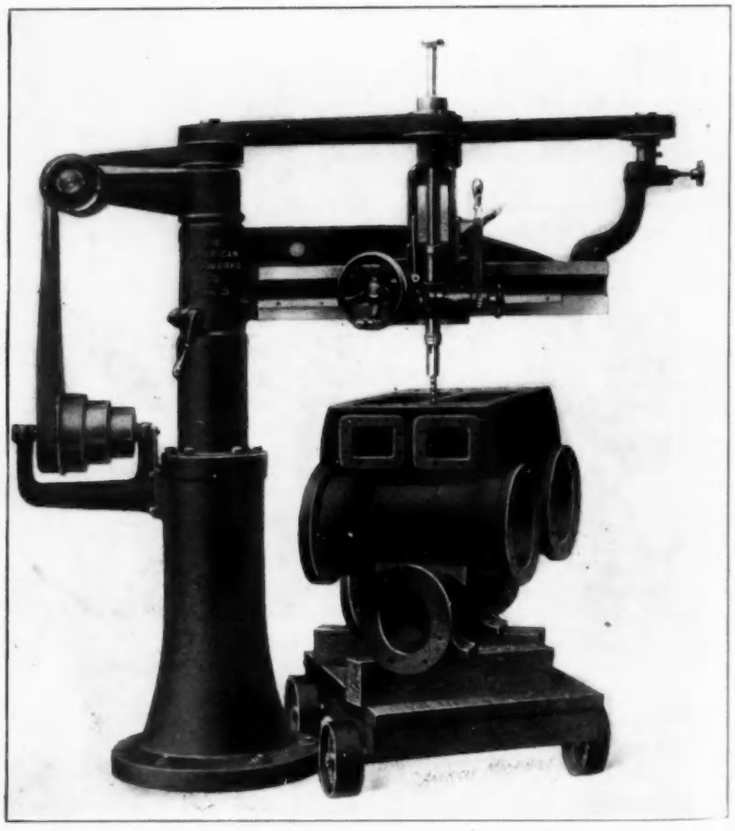


FIG. 2. A 3-FOOT ARM MACHINE WITHOUT TABLE

for further operations. This machine has a 3-foot arm.

These machines are designed for speed up to 900 revolutions per minute, although so far as the machine is concerned, it can stand any speed up to 2000 revolutions without difficulty, all ball bearings being used throughout.

Tests show surface speed of drills from 59 to 248 feet per minute, with feed of from 0.0066 to 0.0037 inch per revolution, and in drilling cast iron with a ½-inch high-speed drill at 137.2 feet per minute, and a feed of 20 inches per minute, 1½ net horsepower was required. The horsepower runs up to 3.7 with a ¾-inch high-speed drill running 900 revolutions or 177 feet per minute, and a feed of 12 inches per minute.

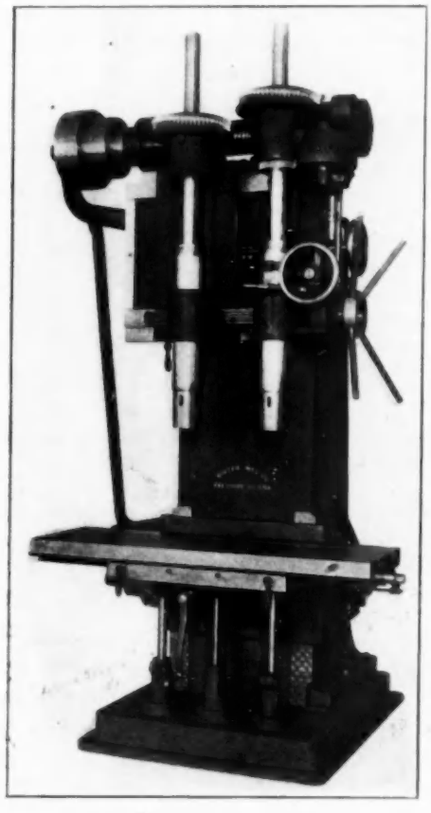
There are no gears in the drive of this machine, all power being transmitted through belts which can be regulated for tension as desired. These machines will handle high-speed twist drills up to 1 inch in diameter, and also standard taps up to 1 inch.

Vertical Cylinder Boring Machine

The two heavy spindle heads are gibbed to the short, stiff cross-rail with the right-hand spindle solidly bolted to the rail, and doweled with taper pins, while the second spindle is adjustable by means of a hand-wheel screw feed to provide for variations in the center distances in different-sized motors. Tapered holes are provided in the adjustable head, so that when jigs have been made for various-sized motors, these holes can be drilled into the cross-rail, thus providing positive stops for each size motor and saving time in locating the heads. The bearing of the spindle sleeve is slotted so as to provide for adjustment.

The spindle sleeves are bushed with interchangeable phosphor-bronze bearings. The thrust bearings are also phosphor bronze. The spindle drive is through a pair of heavy double lead worms, driving phosphor-bronze-faced worm gears.

Four changes of feed have been provided and the entire gearing mechanism is incased in a neat gear box and an adjustable automatic stop is provided for the power feed.



CYLINDER-BORING MACHINE

A long single cross-spindle with teeth cut its entire length drives both spindles uniformly.

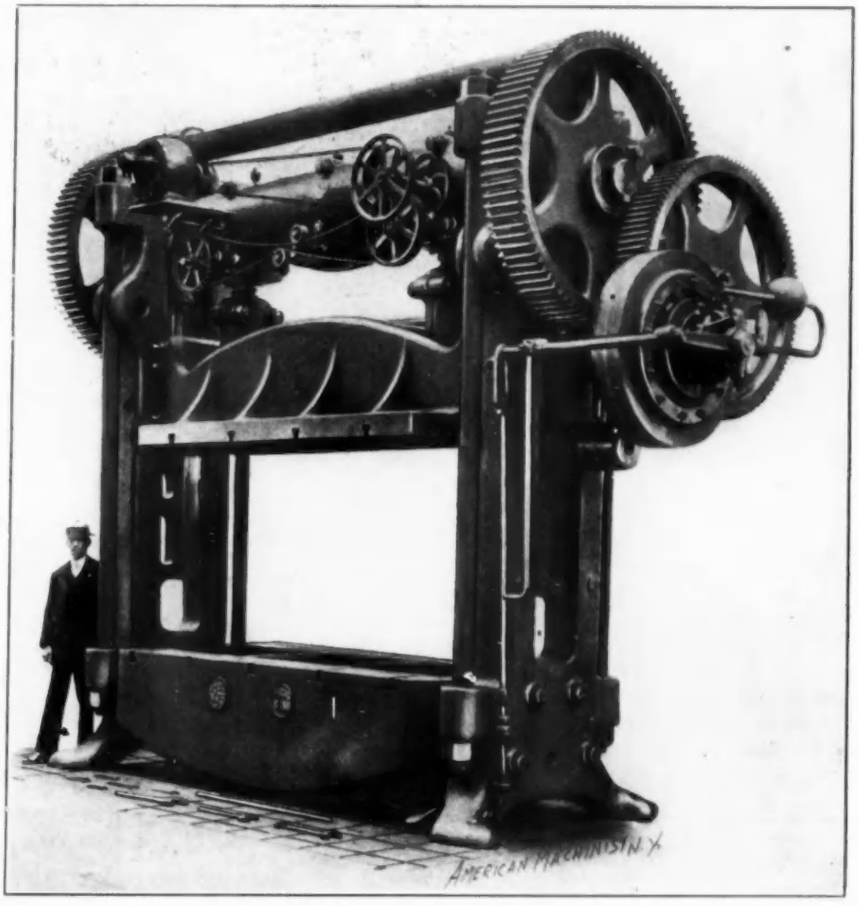
The long table is made stiff to resist springing when the jigs are clamped to it. The traverse is obtained through a coarse lead screw, or a rack and pinion, according to the requirements of the customers.

While the cylinders are being bored others are placed in jigs ready for boring, and run into place under the boring spindles as soon as the first are finished. This insures continuous operations.

The machine is 110 inches long, occupies 52x58 inches floor space, and weighs 8000 pounds. The spindles can be brought to within 9½ inches center distance, or moved 19 inches apart. They are 2⅝ inches in diameter and have a feed of 19 inches. This machine was built by the Hoefer Manufacturing Company, Freeport, Ill.

A New Ferracute Press

The Ferracute Machine Company, of Bridgeton, N. J., has just built a large single-action press that has some unusual features. The illustration shows a massive machine having its vertical columns reinforced with four 4½-inch steel rods, the heavily trussed bed resting on projections from the columns to which it is bolted. The ram is also heavily trussed to obviate any "spring" when the dies come together. Perhaps the most striking feature is the great hight from bed to ram which is rendered necessary by the special work for which the press was designed. This hight, when the ram is at the top of its stroke and adjustment, is 56 inches. A bolster, 24 inches high, is a part of the equipment, reducing this hight when necessary to 32 inches. The distance between columns is 124 inches, and the depth of bed, front to back, is 52 inches. The press has a stroke of 12 inches and a vertical-ram adjustment of 7 inches. Each pitman contains a bevel gear to which is geared a pinion. When the ram is being adjusted, these pinions



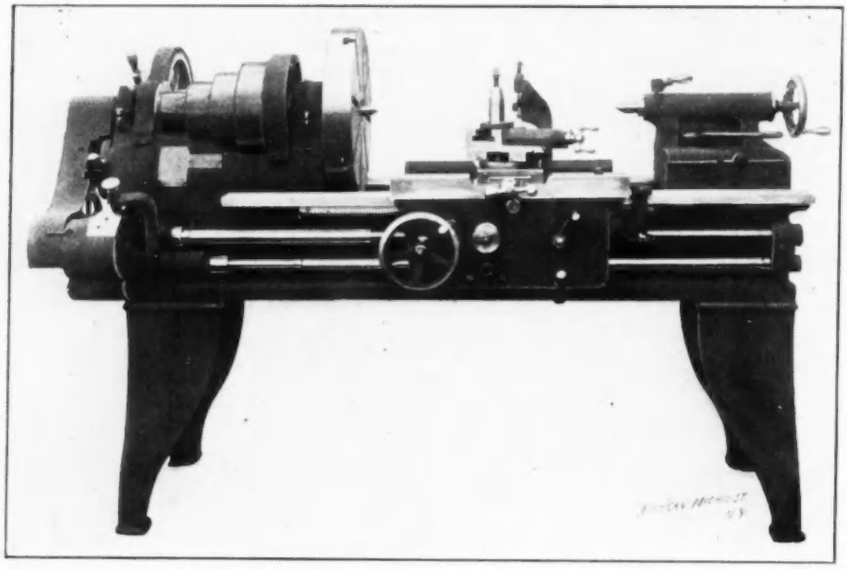
A PRESS THAT WILL TAKE IN 56x124 INCHES

move simultaneously, being connected by a link belt running over sprocket wheels. The belt is kept at proper tension by an ingenious arrangement of idlers. The adjustment of ram may be done by the handwheel, but the electric motor which forms a part of the adjusting mechanism does the work much more rapidly.

The press is double geared, the ratio of gearing being 52½ to 1. The large gears at each end of the main shaft are driven simultaneously by pinions on the heavy back shaft, all torsion of the main shaft being thereby prevented. These gears are 60 inches diameter and 10 inches face. The friction clutch is controlled by a hand lever and brake by means of which the press may be stopped at any part of its stroke. The clutch may be tripped by this lever, or, when in constant use, preferably by treadle. The press makes about 10 strokes per minute. Its hight is 15 feet, width 17 feet 4 inches, and depth, front to back, 7 feet 6 inches. The weight of the press is 52 tons, and it exerts a pressure of 500 tons. It was designed by Oberlin Smith, the president and mechanical engineer of the Ferracute Machine Company.

A Heavy 16-inch Lathe

This is the latest product of the Milwaukee Machine Tool Company, Milwaukee, Wis., being a very heavy 16-inch engine lathe, weighing 2200 pounds with a 6-foot bed. The bed alone weighs about 120 pounds to the foot. The headstock is heavy, carries a four-step cone of generous proportions and has an oil reservoir for each bearing.



A HEAVY 16-INCH LATHE

The feed box is of the cone-gear type with the tumbler gear controlled by the handle shown. This gives four changes of feed under instant control, while these can be changed or any desired thread cut by changing gears at the end of the lathe. A friction disk is used in the gear drive, which allows any desired slipping under overload from any cause.

The carriage is made with a bearing its full length of 23½ inches instead of being recessed and the wings are widened, which shortens the bridge and gives a substantial support for the tool block. The apron has a reverse as well as a safety lock for the half nut, while a chasing dial for assisting in catching threads is attached to the end of the apron as shown.

Bevel Gear Blank Turning Lathe

The accompanying halftones illustrate a special lathe for turning bevel-gear blanks, which is a new product of the Bridgeford Machine Tool Works, of Rochester, N. Y. It turns simultaneously the face, front and back angles of bevel pinions and gears up to 18 inches diameter, although the first operation consisting of boring and facing the back may also be handled advantageously.

The illustrations give a good idea of the general appearance of the machine, Fig. 2 showing the operating position. The frame, oil pan and reservoir are in one piece. The headstock is of similar design to those used on the maker's heavy-duty geared-head engine lathe. The drive is through a constant-speed pulley, 15 inches diameter for 6-inch belt, running 440 revolutions per minute, and there are 12 spindle speeds ranging from 5.8 to 214 revolutions per minute. This construction gives sufficient pulling power to enable three cutting tools to be used up to the limit. All gears within the head are steel and run in oil, and the bearings are self-oiling.

The carriage has a travel of 13 inches, and is provided with two cross slides carrying angle-turning rests, the right-hand

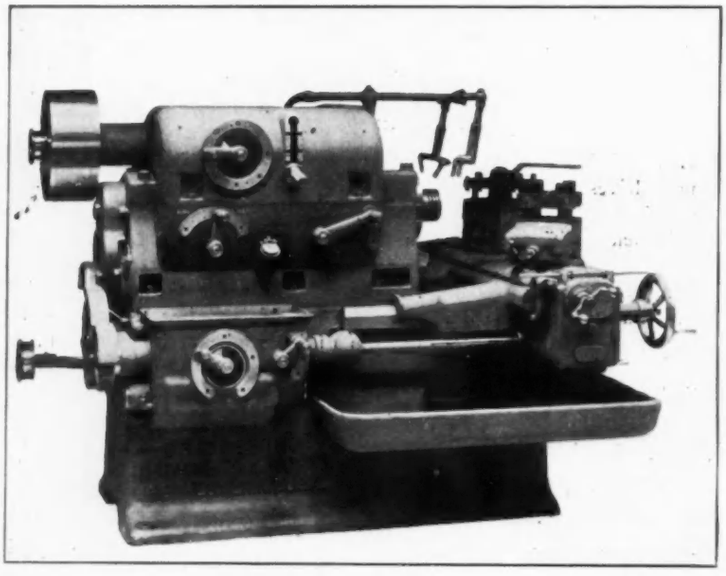


FIG. 1

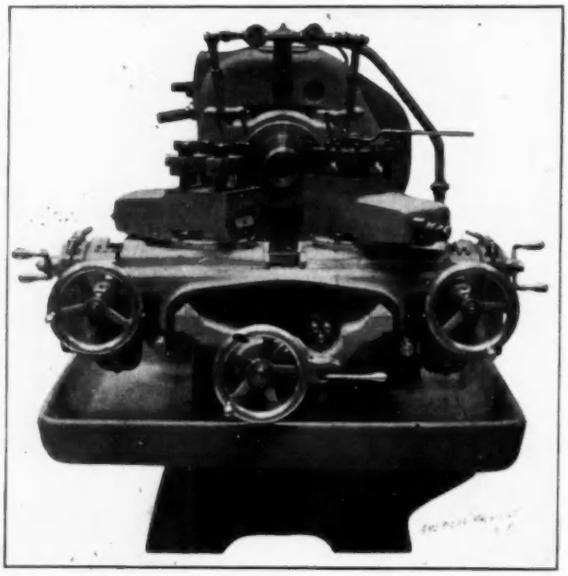


FIG. 2

BEVEL-GEAR BLANK TURNING LATHE

rest having a turret-tool holder. The carriage, cross slides and angle rests have power feed and automatic stops, and handwheels are arranged as shown, within easy reach of the operator for operating the angle rests.

The feed box gives 10 ratios of feed, ranging from 0.005 to 0.190 inch per revolution of spindle, the gears being steel and running in oil.

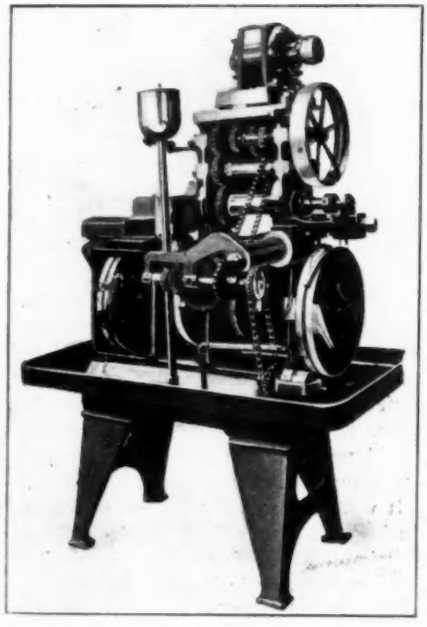
For the first operation the blank is chucked in a universal chuck, bored with a tool in the left-hand rest, while the facing is done by tools held in the turret of the right-hand rest.

For the second operation the blank is either chucked on a special hub or an arbor, in the taper-spindle hole, having a split bushing, the left-hand turning rest carrying a roughing and a finishing tool for the face angle and the turret of the right-hand rest a set of roughing and finishing tools for the front and back angles.

Motor-driven Screw Machine

The new feature of this machine is the driving mechanism with its sliding gears for securing the three speed changes for the spindle. The machine itself is the same as has been built for some time and includes the maker's patented method of camming and the independent cross slides.

They have adopted the device which is



MOTOR DRIVE FOR SCREW MACHINE

used many times on woodworking machinery, of setting small pins in the center of the small driving pulley and using a perforated belt which prevents slipping on the small arc of contact and does away with a belt tightener.

The same speed-changing device can, of course, be used in driving direct from a countershaft and additional changes of speed can be obtained in this way. This is the product of F. E. Wells & Sons Company, Greenfield, Mass.

Duplex Internal Grinding Machines

This is a development of the grinding machine of the Bath Grinder Company, Fitchburg, Mass., illustrated in our issue of March 4, to which a very novel feature has been added. This consists of passing the grinding spindle through the back end of the work-holding fixture instead of running it in from the front end as has usually been done. This, of course, only applies to work having a hole clear through it, although it is not necessary for this hole to be uniform in diameter. The great advantage of this is that it enables the work to be very easily gaged or calipered without losing time by running the grinding head out of the way as is usually done. Fig. 1 shows a gear being held in the right-hand head and the grinding wheel just projecting through it. When this has been fed back the work is ready to be calipered.

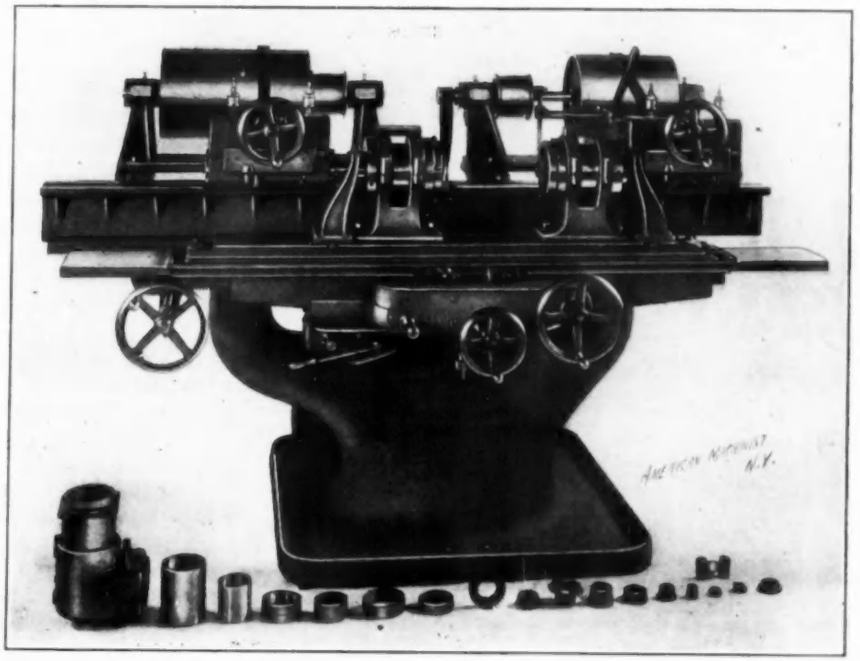


FIG. 1. BATH DUPLEX INTERNAL GRINDER

Both of these headstocks have spindles 8 inches in diameter, and all work up to 6 inches outside diameter is held inside the chuck spindle so as to absorb the vibrations arising from the contact of the wheel with the work. Details of one of these heads, together with a new system of draw-in chucks which has been adopted by the makers of this machine, is shown in Fig. 2. These need little description except to call attention to the false jaws which can readily be made to fit any class of work. These chucks allow the work to be gaged from each end if desired. Gears can either be held from the outside of the teeth, as shown at the left, or the holding jaws, preferably three in number, can be made to catch the gears on the pitch line while being ground. This also shows how a regular chuck is mounted in one of these heads.

The handle next the central handwheel at the front of the machine is a very convenient reverse lever which avoids the necessity of the operator's being careful to stop the table at the end of its stroke. By giving this handle a quarter turn at any time, it automatically stops the table when the end of the stroke is reached, to allow convenient measuring. The internal grinding heads are equipped with an automatic sizing feed which brings the wheel up to the work and are independent of each other. These automatic feeds are operated by hinged arms coming in contact with the end of the square rod shown on the headstock. When the work has been ground to size, an automatic throw-out disengages the feed which can be adjusted for variations of the wheel. These spindle heads are carried on long narrow slides which insure constant alinement. The headstock can be either straight, as shown, or provided with swivels for grinding tapers. Different angles can be ground in each head, or a straight hole can be ground in one and the taper in the other.

A single headstock with a chuck at each end is also provided when desired for grinding in the usual way, as shown in Fig. 3, while Fig. 4 shows a set of seven grinding spindles, the two at the right being mounted on extension arbors, as shown in the machine in Fig. 1. It will be noted that these are provided with

hexagon flanges, doing away with the necessity of spanner or other special wrenches.

An idea of the work accomplished may be had from the consumption of 2.7 horsepower, the large amount of stock being removed being partially due to the use of larger and wider wheels than is usually

16 inches diameter, with a 3⅛-inch hole 6 inches long. They removed 5/32 inch stock in 55 minutes, from a rough-cored hole, with a single spindle. The grinding of a 15/16-inch hole, 1¾ inches long, removing from 0.006 to 0.008 inch in two minutes with a single spindle, was also accomplished.

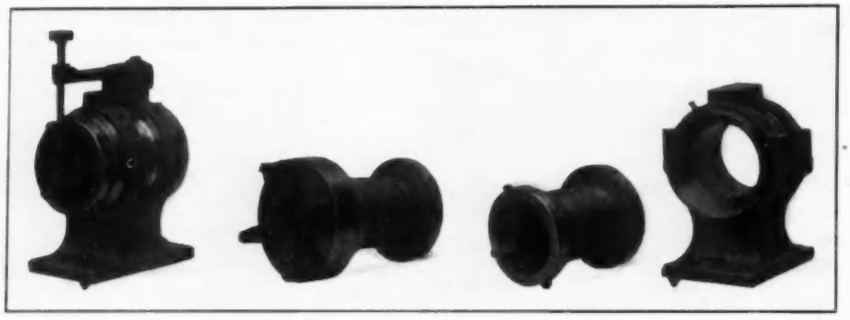


FIG. 2. DETAILS OF THE HEADS FOR HOLDING WORK

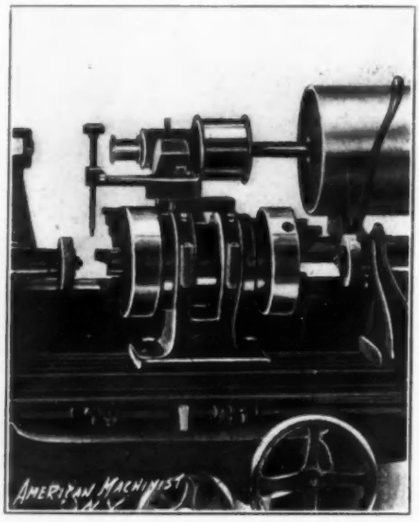


FIG. 3. DOUBLE HEAD WORK HOLDER

With the machine is furnished a supported spindle that can be mounted on each end of the spindle head the same as single spindles. On this can be mounted from one to six grinding wheels, as, in grinding a bushing 2½ inches diameter, 2 inches long, the wheels would be spaced the length of the bushing apart, and they would pass over the six wheels before being reversed.

Another method is to hold the bushing in a spring collet. The two single-ended grinding wheels can then be brought up together and grind at the same time, and remove the stock to within 0.001 or 0.002 inch of size. Then one of the wheels can be stopped and the hole finished with a single wheel. Still another method is to use a coarse wheel to rough and a fine wheel to finish. Such work as pneumatic hammers, having four bearings to be

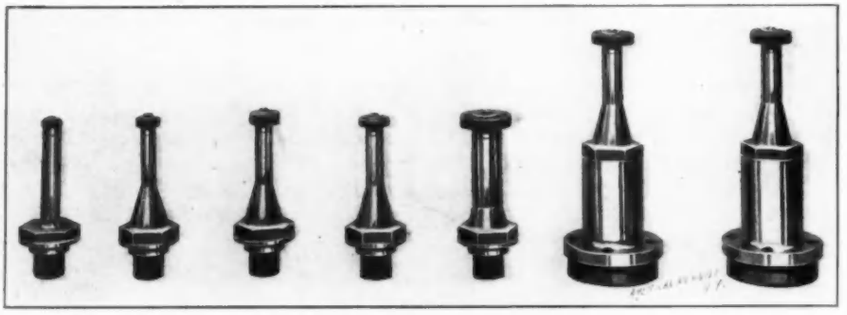


FIG. 4. SPINDLES FOR A VARIETY OF WORK

the case in internal grinding, and also to the rigidity of the headstock for holding the work.

A brake is provided so that the driving drum can be stopped in four seconds, and the machine is also equipped to be used with water.

Among the work recently ground on this machine were some manganese car wheels ground concentric with each other, can be ground without reversing the work.

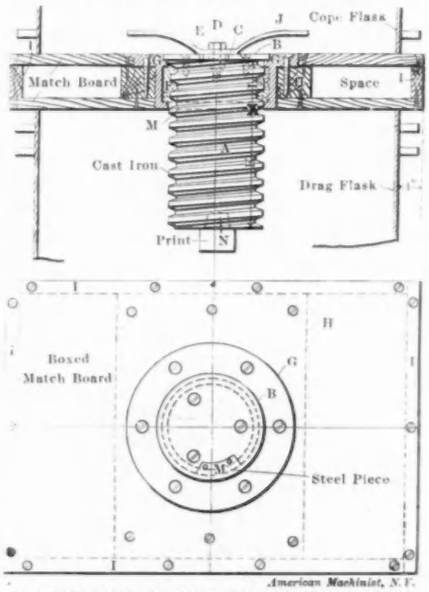
Twelve billion dollars' worth of manufactures have been exported from the United States in the last 120 years, $8,000,000,000, or two-thirds, of this enormous total within the last 20 years, and $6,000,000,000, or one-half, in the last 11 years.

Pattern and Rigging for Molding Worm Screws

By M. E. Dawson

The method most commonly used to make a wooden pattern for a worm screw is to part it in the center and mold on the side. This way is good if no better is at hand. However, I have learned from experience and when measuring worm-screw castings, made from split patterns, that there is more or less shift in the pattern, or irregularity in the diameter of the casting, or both. While these may not be sufficient cause for complaint or the rejection of the casting, a better method for making a pattern that will produce a good casting will be appreciated.

In the accompanying line cut is shown, in plan and vertical section, the method



PATTERN AND RIGGING FOR MOLDING WORM SCREWS

in use by one of the companies making machinery on which is used the wheel and worm to quite an extent. Both steel and iron castings are used which are as near perfection as can be expected in a casting. True, it would not pay to go to the trouble and expense of making this outfit where only a few castings are required.

It would be well for patternmakers and draftsmen to study the general conditions, shrinkage, etc., of castings, particularly steel castings, made in the foundry where they are employed; better still, if the pattern is sent to several outside foundries, as in this way they can compare the results of each foundry.

Here is a case that happened only a week ago in the factory where I am employed. A pattern for a steel cut spur gear was made and sent to an outside foundry. The pattern was 5 feet 3¾ inches diameter with a 4-inch face and six arms. The shrinkage allowance on this was ¼ inch to the foot and when the

steel casting was checked up it was found to be 7/8 inch too large in diameter, which was cause enough to reject it. Another casting made from the same pattern, at the same foundry shrank 7/16 inch less than the first, yet it was 7/16 inch too large.

A split pattern from which a steel worm screw is to be cast should have at least twice the amount of clearance in the teeth that it would have if in cast iron. A lack of sufficient clearance in cast-steel gears and worm screws has been the cause of much delay and labor in the machine shop where I am employed. Castings made from the jig shown require less clearance than if made from a split pattern. In the accompanying line cut are shown two views of a match-plate and worm-screw pattern, which is a radical departure from the split pattern. The pattern is made solid and molded on end as shown in the upper view.

The piece shown by *A* is a cast-iron worm screw that was turned, finished and polished from a solid piece. A few, that gave better satisfaction, have been made from a solid bar of machine steel. This was due to the closer grain of the metal and the higher polish that could be given the pattern, which is a big help in removing it from the sand and leaving a perfect mold. *K* is the length of the casting to be used, and $K + L$ is the length of the pattern over all. The dimensions of the pattern from which this sketch was made are: Root, or body, 4 inches diameter; points, or outside, 5½ inches diameter, and pitch, 1¼ inches; *C* at the top, and *N* at the bottom are taper holes to receive the core prints. At the bottom of *C* is a ½-inch drilled and tapped hole; *B* is a ½-inch cast-iron plate, finished all over, and bolted to the worm pattern with three screws; *J* is a forged lever shaped as in sketch and having a 1-inch taper dowel pin *E*, which fits into a hole in the top of plate *B*; *G* is a round cast-iron piece machined all over excepting in the babbitt chamber *F*.

It is common practice to make match plates from ⅛ to 1¼ inches in thickness; here you will notice the match plate is boxed and measures about 2⅞ inches in thickness. It consists of ends, sides, top, bottom, and a center piece. This last is most important, as it stiffens the board as well as receiving the casting *G*.

The center of casting *G* is bored out to fit loosely over the outside of the worm-screw pattern; the top is counterbored to receive plate *B*, and six screw holes are drilled and countersunk for wood screws. The match board is turned out in the center to receive casting *G*, as it is important to have the top and bottom of the match board flush with this casting. The match board is about 1 inch larger all around than the flask.

When the pattern and matchboard are assembled, as in the sketch, babbitt is poured into the chamber *F*, thus making the match board a big nut, with 2½ or 3 threads.

At *M* the babbitt in the nut forms a thin edge. This thin edge is cut away and a piece of steel put in its place. This piece *M* is shown in its place in the lower view.

The match board is laid down and the drag flask is put on and rammed up. The flask and pattern are then rolled over and the cope is placed on and rammed up, with proper runners and vent. The cope is then lifted off and the handle *J* put on and fastened with screw *D*, by means of this handle the worm-screw pattern is drawn out of the sand by screwing it up through the nut or match board. The matchboard is next removed and the cope put on after setting the center core.

Forthcoming Meetings

National Machine Tool Builders' Association, fall meeting, October 12 and 13, New York City. P. E. Montanus, secretary, Springfield, Ohio.

National Society for the Promotion of Industrial Education, annual convention, December 1, 2 and 3, Milwaukee, Wis. J. C. Monaghan, secretary, 20 West Forty-fourth street, New York City.

Business Items

The jury of awards, who examined the exhibits and rendered decision on the saw displays at the Alaska-Yukon-Pacific exposition, has awarded a grand prize to Simonds Manufacturing Company, Fitchburg, Mass.

Business Opportunities

Geo. H. Miller, Sheboygan, Wis., will erect a candy factory.

The Leithead Drug Company, Duluth, Minn., will build a garage.

Thomas Hood & Co., Athens, Ga., will establish a machine shop.

The Appleton (Wis.) Wire Works will build addition to its plant.

The Felch (Mich.) Creamery Company will build a creamery.

The Red Bank (N. J.) Water Works is enlarging its power plant.

A. P. Buckholz will erect a pickle factory at Chippewa Falls, Wis.

Frank Beatson, Spalding, Mich., will erect a creamery or cheese factory.

Fire destroyed the sawmill of the Polar (Wis.) Manufacturing Company.

The Edgar Veneer and Box Company, Wausau, Wis., will erect a new plant.

The Bolivar (Penn.) Foundry and Machine Company is erecting a new foundry.

The American Woolen Company, Winooski, Vt., is building an addition to its mill.

The plant of the Traverse City (Mich.) Chair Company was destroyed by fire.

The Gardner Harvey Paper Company, Middletown, Ohio, is building a new plant.

The Harvey Spring Company, Racine, Wis., will increase the size of its power plant.

The Victor Lamp Company, Cincinnati, Ohio, is preparing to build a new plant.

The American Motor Casting Company, Detroit, Mich., will erect a $30,000 building.

The Paine Lumber Company, Oshkosh, Wis., will build an electric power plant.

Fire in the foundry of the Eagle Iron Company, Salem, Mass., caused $4000 damage.

The Kaukauna (Wis.) Lumber and Manufacturing Company will build an addition.

The U. S. Brown & Brush Company, Chicago, Ill., will erect a new $75,000 factory.

The Fort Smith (Ark.) Refrigerator Company is doubling the capacity of its plant.

The Barnett Drop Forge Company, Easthampton, Mass., will erect a power house.

The Zenith Furnace Company, Duluth, Minn., is building an addition to its foundry.

Regling Brothers, Shawano, Wis., will erect a plant for the manufacture of cement blocks.

The Janesville (Wis.) Motor Company is erecting a two-story garage to cost $15,000.

The Leader Iron Works, Decatur, Ill., will build a new boiler room and install two new boilers.

Parsons Bros., Incorporated, Brooklyn, N. Y., dyers and bleachers, are erecting an addition.

The Oliver Iron Mining Company will erect a plant at North Freedom, Wis., to cost $250,000.

The Wisconsin Art Cabinet Company, Fond du Lac, Wis., will build an addition to its plant.

The Northern Milling Company, Wausau, Wis., is contemplating installing electric equipment.

The Superior (Wis.) Water, Light and Power Company will install additional equipment.

H. F. Read, Enosburg Falls, Vt., is erecting a new building to be used as machine shop and garage.

The Sheboygan (Wis.) Fruit Box Company will build a three-story factory. Also power plant.

Bonds have been issued at Crandon, Wis., for construction of electric-light plant and water works.

The Detroit (Mich.) Fuse and Manufacturing Company has had plans prepared for a new factory.

The Aberdeen (S. D.) Light and Power Company has taken out permit for a new power house.

The Middleport (N. Y.) Gas and Electric Company will install two oil engines in its power house.

C. A. Straubel, 409 North Washington street, Green Bay, Wis., will erect a cold-storage plant.

R. E. Dwinell & Co., Amherst, Wis., are making extensive improvements on their electric-light plant.

The Minneapolis (Minn.) Motor and Truck Company has had plans prepared for a $100,000 factory.

The Stoughton (Wis.) Wagon Company is building an addition. Will manufacture manure spreaders.

The Union Manufacturing Company, Oconto Falls, Wis., will erect an additional building for its box factory.

A. Holmon & Zion, Sheboygan, Wis., will establish an overall and shirt factory at 2118 West Twelfth street.

The Clark Motor Car Company, Shelbyville, Ind., is receiving bids for construction of factory buildings.

The Koehring Machine Company, 616 Germania building, Milwaukee, Wis., will erect a new machine shop.

The Upson Nut Company, Cleveland, Ohio, is said to be planning the building of four open-hearth furnaces.

H. Steinbach & Co., Asbury Park, N. J.,

will enlarge its power plant. Will install new engine and boiler.

The Packard Motor Car Company, Detroit, Mich., has started the erection of an addition to be used as a foundry.

The Grossman Wardrobe Company, Sparta, Wis., is to engage in the manufacture of display and store fixtures.

The wire-nail plant of the Globe-Taunton Manufacturing Company, Taunton, Mass., was burned. Loss, about $50,000.

The Faries Manufacturing Company, Decatur, Ill., making hardware specialties, will increase the capacity of its plant.

The Bush Terminal Company, Brooklyn, N. Y., is erecting two additional buildings. Two elevators are to be installed.

Joseph Sawyer, Oswego, N. Y., is having plans prepared for a new brass foundry to replace the one recently burned.

L. Kissell & Sons, Hartford, Wis., have formed a new company for the purpose of manufacturing manure spreaders.

The De Pere (Wis.) Electric Company will spend $10,000 for new equipment and change from alternating to direct current.

Fire destroyed more than half the plant of the American Axe and Tool Company, Beaver Falls, Penn., causing a loss of $75,000.

The Michigan Oak Flooring and Interior Finish Company, Pontiac, Mich., recently incorporated, has purchased site for a plant.

Work has been begun by the Chicago, Burlington & Quincy Railroad on new shops at Havelock, Neb. These are to cost $1,500,000.

J. W. Wells, president of Wells Brothers' Lumber Company, will erect a maple-flooring factory at Menominee, Mich., to cost $150,000.

The Gasport (N. Y.) Motor Company is building a new factory. Will manufacture spraying machines in addition to gasolene engines.

The Reliance Motor Cycle Company, Owego, N. Y., is to construct machine-shop addition and engage in the manufacture of automobiles.

The American Rolling Mill Company is building an addition at its plant in Zanesville, Ohio. Six new annealing furnaces will be installed.

The Standard Sanitary Company, of Pittsburg, Penn., will establish a branch factory in Toronto, Ont., on which it is said $3,000,000 will be spent.

Henry Tiedeman, manufacturer and inventor, Menominee, Mich., will establish the Menominee Tool Company, and erect a plant to cost $60,000.

The Menasha (Wis.) Paper Company will purchase second-hand Corliss engines. Is also in the market for pumps, condenser and electric generators.

Work has been commenced on the new $5,000,000 cotton mills to be erected for the Maverick Mills Company on Chelsea creek, East Boston, Mass.

The Dirigo Manufacturing Company, Fairfield, Me., manufacturing agricultural implements, will move to Old Town, where a new plant will be erected.

The S. H. Roberts Boiler and Tank Company, of Mars, Penn., is estimating on a new plant to be erected at Queens Junction, Penn., to which place it will move.

A. L. Thompson, of Marinette, Wis., will engage in the manufacture of kerosene-oil engines. Was formerly with the Prescott Company, Menominee, Mich.

The Sternburg Manufacturing Company, Milwaukee, Wis., will erect a factory in West Allis for the manufacture of auto trucks, police-patrol trucks and delivery trucks.

The Tips Foundry and Machine Company, Austin, Texas, will probably rebuild its plant, recently burned. The company manufactures gasolene engines and centrifugal pumps.

The Ingersoll Milling Machine Company, Rockford, Ill., is erecting addition which is to be used for the manufacture of the smaller size machines. Fifty more men are to be employed.

The Lawrence Iron and Steel Foundry Company, Pittsburg, Penn., formerly the Yagle Foundry and Machine Company, is to enlarge its plant and make steel castings almost exclusively.

The United Machine Company, Detroit, Mich., will move to Angola, Ind., where a new plant has been erected. Will manufacture automobile engines in addition to refrigerating machines.

The New Iberia, Loreanville & Northwestern Railroad Company, which is being promoted by F. M. Welch, of New Orleans, La., has started construction work on the road. This is to be 43 miles long.

The Public Service Company, of New Jersey, is building a repair shop at South Nineteenth street and South Orange avenue, Newark, N. J. Will probably need equipment. Main offices are Prudential building, Newark.

Owing to increase of business it has become necessary for the Remington Typewriter Company to enlarge the capacity of its factory at Ilion, N. Y., and orders are to be placed for an additional power unit and for machine-tool equipment amounting to about $50,000.

The Hays Rapid Tunneling and Mining Machinery Company, Birmingham, Ala., has purchased site for a plant at Queenstown, near Birmingham, and will shortly commence construction. Mining and tunneling machinery, turbines and mine pumps will be manufactured.

The Van Loozen Multicolored Printing Press Company is being organized at Bucyrus, Ohio, to take over the business of the Van Loozen Automatic Printing Press Company, of Cleveland. New plant is being erected at Bucyrus. Equipment, including lathes, planers, drills, milling machines, is needed.

Bids will soon be received for equipment for State prison, Oak Park, Minn., including boilers, engines, motors, blowers, refrigerating machinery, condensers, separators, crane, conveying machinery, ventilating apparatus, etc. Chas. L. Pillsbury, Metropolitan Life building, Minneapolis, is engineer.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: Sept. 28—Surveyor's transits, sextants, etc. (schedule 1701), steel springs (schedule 1704), steel bolts, nails, wrenches (schedule 1704), steel die blocks (schedule 1704), sheet brass, copper and iron bar, galvanized sheet steel (schedule 1706), structural steel (schedule 1710); Oct. 5—Marine water-tube boilers (schedule 1690), milling machines, 20-inch belt-driven shapers (schedule 1689); Oct. 12—Voltmeters, etc. (schedule 1692).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: Oct. 5—Boiler grate bars, spare parts for pumps (schedule 1716), wire tube brushes, grease cups (schedule 1715), steel and bronze springs (schedule 1719), steel angles, rod and sheet bronze, steel (schedule 1721), pipe fittings (schedule 1714); Oct. 12—Flat cars (schedule 1727), engine lathe (schedule 1730), hydraulic pressure pumps, boiler feed pumps (schedule 1728), motors (schedule 1730), dynamotors, testing generators, testing sets, ventilating sets (schedule 1711).

New Incorporations

Warren Automobile Company, Detroit, Mich. Manufacture automobiles.

Lyon Motor Car Company, Adrian, Mich. Manufacture automobiles.

L. D. Durant Company, Oxford, Mass. Manufacture wooden boxes. Capital, $50,000. L. D. Durant, president.

Pittsburg Paper Can and Tube Company, Pittsburg, Penn. Manufacture paper cans and tubes and metal disks. Capital, $50,000.

Vogel Car Manufacturing Company, St. Louis, Mo. Will manufacture automobile trucks and vehicles. Capital, $75,000. H. L. Vogel, president.

Davenport Can Company, Jersey City, N. J. Manufacture cans, etc. Capital, $150,000. Incorporators, J. A. Laing, J. J. Treacy, Seney Plummer.

Emergency Forge Company, Lansing, Mich. Manufacture drop forgings. Capital, $100,000. Incorporators, Chas. P. Downey, Jas. B. Seager, S. B. Seager.

The Precise Company, Indianapolis, Ind. Manufacture machinery. Capital, $10,000. Directors, A. Afanador, J. E. Parker, O. W. Morgan, H. L. Lobach.

The Wright-Rye Motor Company, Troy, N. Y. Manufacture automobiles, boats, etc. Capital, $40,000. Incorporators, W. D. K. Wright, W. H. Rye, etc.

The Nohe Electric Renovator Company, Chicago. Manufacture electrical devices. Capital, $25,000. Incorporators, G. Laugheney, A. W. Nohe, J. V. Crane.

Pell Motor Car Company, Oswego, N. Y. Manufacture automobiles, parts, etc. Capital, $150,000. Incorporators, C. C. Place, A. N. Radcliffe, D. W. Pell.

Ideal Auto Starter Company, Indianapolis, Ind. Manufacture auto parts. Capital, $25,000. Incorporators, W. K. Bellis, S. P. Woodward, R. T. Snapp and others.

New Hygienic Refrigerator Company, Indianapolis, Ind. Manufacture refrigerators. Capital, $25,000. Incorporators, Frank M. Smith-Harry F. Smith, C. Claussen.

The Lecompte Company, Chicago, Ill. Manufacture railway and other supplies. Capital, $500,000. Incorporators, Louis Lecompte, Joseph Lecompte, E. S. Masterson.

The Yankee Wood Turning Company, Huntington, Conn. Capital, $10,000. Incorporators, E. A. Harriman, New Haven; A. C. Baldwin, Huntington; H. E. Drew, Ansonia.

Addressing Machine Company, Buffalo, N. Y. Manufacture addressing machines. Capital, $150,000. Incorporators, W. J. Golden, W. Murphy, I. E. Waters.

Gurney Ball Bearing Company, Jamestown, N. Y. Manufacture machinery, ball bearings, etc. Capital, $600,000. Incorporators, A. W. Kettle, F. W. Gurney, W. H. Kidder.

Cataract Motor Company, Paterson, N. J. Manufacture motor vehicles, engines, etc. Capital, $350,000. Incorporators, L. A. Plaget, W. H. Sherman, F. W. Freeman, etc.

Washington Engine Works, New York. Manufacture engines, boilers, etc. Capital, $50,000. Incorporators, W. A. White, A. White, West Hoboken, N. J.; B. H. Oliver, New York.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us re-

garding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E. G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Second-hand turning lathe, cross feed screw cutter, 8"x6', 16"x8'. Box 709, AMERICAN MACHINIST.

Wanted—To purchase or manufacture on royalty, a small tool or similar device. Box 683, AMERICAN MACHINIST.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

First-rate German house wishes offers for vulcanized fiber. Answers to K. U. 8424, Rudolf Mosse, Cologne-on-Rhine, Germany.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinists and engineers blueprint chart of United States Standard pipes and tapping sizes from ⅛" to 10" pipe. Price 10 cents per copy postpaid. Liberal discounts to shop agents. Address Charles Kuderer, Woodlawn, Penn.

Automatic and special machines, dies, models designed, inventions developed, tool equipments planned, working drawings; prices reasonable; satisfaction assured. Address C. E. Buffington, M. E., 92 Market Street, Newark, N. J.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Factory manager, superintendent or master mechanic; I have a clean record for profitable results obtained in some of the largest concerns in the country; this record was made on merit. Somewhere there is a firm that can use my services; I want to get in touch with them; young, competent, thoroughly practical executive; especially strong on design of special machinery and labor-saving devices; I want to hear from someone with a good opening. Box 728, AM. M.

ILLINOIS

Expert on small interchangeable work wishes position as superintendent or assistant, thoroughly qualified, executively and mechanically; A-1 references as to ability and character. Box 738, AMERICAN MACHINIST.

Shop foreman; have 15 years' shop experience, or foreman of screw-machine department, having had charge of 25 Brown & Sharpe automatic and 20 hand machines for the last ten years; can lay out cams and design tools for same; up-to-date in modern shop methods; also shop systematizer. Box 721, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—Position as foreman patternmaker; will give immediate evidence of ability. Address Box 705, AMER. MACH.

Wanted—A position as superintendent, who has had a large experience in the manufacture of plumbers' supplies and sanitary specialties and general brass goods manufacturing; can handle help and produce the goods; not particular as to location. Box 710, AM. M.

A mechanical superintendent and production engineer of practical experience, successful in increasing production and reducing cost of manufacturing; good organizer, energetic; can obtain highest quality and quantity of work from employees; invites correspondence from parties requiring competent men; single, and location immaterial. Box 711, AM. MA.

MICHIGAN

Wanted—Position by mechanical draftsman and machine designer, with ten years' experience in United States and Germany; can furnish very best reference. P. O. Box F, Saginaw, Mich.

Technical graduate, 27; seven years' experience in shop, drafting room, cost and organization work; now chief draftsman and shop systematizer; but would like position in or near Detroit, where hard work and advancement are needed. Box 703, AM. MACH.

NEW JERSEY

Mechanical engineer, chief draftsman and designer, experienced on pumping machinery and steam engineering, is open for responsible position. Box 714, AMER. MACHINIST.

Wanted—By experienced mechanic, wishing change, position as tool room or general shop foreman; up-to-date in modern shop methods; at present holding similar position; good references; location, not material. Box 723, AMERICAN MACHINIST.

Superintendent or assistant; 43; now employed; good organizer and executive; efficient in modern methods, machine shop and manufacturing; broad experience as foreman and superintendent; best references from present and previous employers. Box 712, AMERICAN MACHINIST.

NEW YORK

Designer, special and automatic machines, wants position. Box 733, AMER. MACHINIST.

Mechanical draftsman; young man, five years' shop and three years' drawing-room experience, desires position. Box 718, AM. M.

Mechanical engineer and designer, seven years' practical experience in drafting room and shop; wants position offering a future; good references. "H. L.," Box 699, AM. MA.

A young, up-to-date toolmaker; 18 years' experience; first-class on all kinds of tools and experimental work; also held position as inspector, desires responsible position. Box 717, AMERICAN MACHINIST.

American, age 26 years, desires to locate anywhere in the Middle Atlantic States, as assistant to live superintendent of concern manufacturing machinery. "Competent," Box 732, AMERICAN MACHINIST.

Technical graduate, 36, desires position as manager, assistant or superintendent; fifteen years' experience in shop, drafting room and office; capable designer of special tools and familiar with best systems of production and of cost accounting and factory maintenance. Box 734, AMERICAN MACHINIST.

Wanted—About November 1, position as machinery sales-engineer; have technical education (Stevens), shop and drawing-room training; 10 years' machinery selling experience; eight years with one firm on power transmission; an extensive engineering and shop acquaintance in United States and Canada; A-1 references. Box 704, AM. MACH.

Active, efficient man, excellent record as inventor, designer and superintendent with concern manufacturing typewriters, wishes position with good future; New York City preferred; well posted on cost and record systems, and capable of designing simple and effective mechanisms and producing results in shop management; technical education; age, 30 years; salary, $5000. Box 713, AM. MA.

OHIO

Salesman, 27, technical graduate with good mechanical experience, desires position with manufacturer or jobber. Box 722, AM. MA.

PENNSYLVANIA

Tool room foreman and designer, desires change; 17 years' experience; best of references. Box 719, AMERICAN MACHINIST.

Draftsman wishes position; five years' experience in engineering work; technical education; neat and fast worker. Address "A. C. F.," AMERICAN MACHINIST.

Situation Wanted—Draftsman, six years' experience; especially proficient in sheet metal and boiler work; experienced in heavy machine work; Middle West preferred. Box 720, AMERICAN MACHINIST.

Superintendent; large, general experience, especially along pneumatic lines; last three years, compressors and vacuum-cleaning apparatus from smallest hand to largest stationary plants; East preferred. Box 731, AMERICAN MACHINIST.

Patternmaker seventeen years; eleven years with one firm, seven as foreman; willing to change for improvement; capable of improving foundry equipment, including patterns and molding methods; experienced with molding machines. Box 736, AMER. MACHINIST.

RHODE ISLAND

Superintendent, experienced in organization and production in manufacturing machine shop and gray-iron foundry, desires responsible position with progressive company. Address Box 735, AMERICAN MACHINIST.

WISCONSIN

Man with 20 years' experience as superintendent and manager of large machine works is open for an engagement October 1. Applicant is fully qualified to assume entire charge of office and works as its official head. Have good executive ability, good organizer and can produce maximum amount of work at minimum cost. Box 666, AMER. MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—First-class toolmakers on punches and dies; steady work to competent men; wages 35 to 40 cents per hour. Apply to Canadian General Electric Co., Ltd., Peterboro, Ont.

Thoroughly competent young man, with mechanical and executive experience, to take an interest with a view of purchasing a fully equipped machine shop, located in large city in Western Washington; plant is in operation, making gasolene engines, canning and saw-mill machinery, besides doing general jobbing work; splendid opportunity for the right man, with a few thousand dollars, anxious to acquire a business for himself, that will be a money maker from the start. Answer stating age, nationality, experience and references. Answers will be treated confidentially. Box 700, AMERICAN MACHINIST.

CONNECTICUT

Wanted—A first-class toolmaker on jig and fixture work. Box 621, AMER. MACHINIST.

Wanted—Three or four good draftsmen on jigs and fixtures, also light special machinery; none but really good men need apply. In answering give full particulars as to past experience, special ability and wages expected. The Noiseless Typewriter Co., Middletown, Conn.

ILLINOIS

Man wanted, experienced in running large radial drills on heavy work. Box 708, AM. M.

Wanted—Experienced foreman in gasolene engine factory, for machine shop; good organizer, and capable of getting out the work at minimum cost; give all particulars in first letter; steady work. Box 701, AMER. MACH.

Wanted—A factory foreman familiar with gasolene engine building (two and four cycle); marine experience preferred; must be thoroughly uptodate on economic production of high-grade work in large quantities, jigs, templets, contract work, etc. State age, experience and salary wanted. Box 702, AM. M.

INDIANA

Two experienced foremen for machine and assembling rooms, manufacturing gasolene motors. Give reference, experience and age. Box 262, AMERICAN MACHINIST.

KANSAS

Wanted—Foreman for machine department of automobile plant, one that can instruct help and get out good work. Box 706, AM. M

MASSACHUSETTS

Wanted—First-class draftsman. Supervisor of Drafting Rooms, General Electric Co., Pittsfield, Mass.

Wanted—Machinists; first-class men on engine and pump work as layout men, lathe hands, planer hands, drilling, boring, etc.; good pay and steady work; works near Boston. Address Dept. 52, P. O. Box 167, Boston, Mass.

Wanted—A young man of high character, correct habits, good education and successful shop experience as machinist and toolmaker, for position as instructor in a Massachusetts city; please state age, training and experience, present position and references. Box 716, AMERICAN MACHINIST.

Wanted—Applications from erectors, layout men, production men, brass finishers, machine and hand molders, and operators for lathe, planer, drill, turret machines, boring mill, etc.; heavy and light work. Address Dept. 54, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

Wanted—Thoroughly competent young man with some mechanical and executive experience to act as assistant superintendent in a small thoroughly equipped progressive factory manufacturing small tools, located in a large city in Western New England. Owing to certain conditions right man has an unusual opportunity for speedy advancement. In sending application state fully in detail all qualifications, for whom you have worked, present position, salary expected, etc. Box 638, AMERICAN MACHINIST.

MICHIGAN

Wanted—A first-class lathe hand; must be thoroughly familiar with the Lodge & Shipley patent headstock lathe and capable of instructing operators; state experience, age and wages expected. Apply Buick Motor Co., Flint, Mich.

Wanted—Man to take charge of tool crib; must thoroughly understand the most upto-

date systems for keeping tools and checking; only applications from thoroughly first-class reliable men will be considered; give full particulars of experience, references, age and wages expected. Apply Buick Motor Co., Flint, Mich.

NEW JERSEY

Draftsmen—Experienced men on general engineering and construction for large industrial plant; location, New Jersey, vicinity of New York City; state experience, age and salary. Box 730, AMERICAN MACHINIST.

NEW YORK

Competent jig designers wanted. American Machine and Foundry Co., 346 Carroll St., Brooklyn, N. Y.

Wanted—Mechanical draftsmen, experienced in electric traveling crane designing. Box 633, AMERICAN MACHINIST.

Sales manager wanted for large machinery and supply house; knowledge of German desired; state full particulars, references, salary, etc. "Executive," Box 725, AM. MACH.

Wanted—A few experienced mechanical draftsmen. Apply Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y., giving experience, age and salary expected.

Wanted—First-class Norton and Landis grinder hands; also good lathe hands on crank-shaft work. P. H. Gill & Sons Forge and Machine Works, Lorraine and Otsego Streets, Brooklyn, N. Y.

Mechanical engineer wanted by large machinery house; experienced in selling machine tools absolutely essential; state full particulars, references and salary. "Hustler," Box 727, AMERICAN MACHINIST.

Experienced mechanical engineer wanted for selling gear-cutting machines; only applications with full particulars as to experience, references, salary desired, will be considered. "Chances," Box 726, AMERICAN MACHINIST.

Wanted—General foreman for iron machine shop, one experienced in economical production of iron valves preferred; state salary expected, age and experience; also if now employed. Box 682, AMERICAN MACHINIST.

Lathe, planer and boring mill hands wanted for day and night shift; no labor troubles, increasing force; applicants must state wages desired, past experience, if employed at present, and the names of past employers, to receive further consideration. Application considered confidentially. Apply Ingersoll-Rand Co., Painted Post, N. Y.

Wanted—High-class factory superintendent to take charge of plant employing 750 hands; eight acres of floor space, 1800 machines; plant includes machine shop and tool room for manufacturing all tools and machinery in use; none but first-class men need apply; one with technical education preferred. Box 640, AMERICAN MACHINIST.

Wanted—A thoroughly practical and energetic mechanic to take a position as rate fixer on premium work in the shop, building high-speed engines; must be familiar with jigging work and fixtures; must have fair education, good at figures and systematic; must be able to go into machine shop and make demonstrations. Apply stating age, nationality and previous experience, also whether employed at present and by whom. Answers will be treated confidentially. Box 715, AM. M.

OHIO

Machinist. 201 Nicholas Bldg., Toledo, O.

Wanted—Experienced high-class machine tool salesman. Box 737, AMER. MACHINIST.

Machinists wanted on machines and erecting floor. Lima Locomotive and Machine Co., Lima, Ohio.

Wanted—Manager, who can obtain some capital, for modern machine works, running day and night, located in Ohio. "Engineers," Box 678, AMERICAN MACHINIST.

Wanted—General superintendent with wide experience and progressive methods in factory operation and production, by an office specialty manufacturing company; in writing, give age, experience, references and salary expected. All correspondence will be treated strictly confidentially. Box 687, AM. MACH.

Wanted — First-class machinists, lathe, planer, drill press, screw machine, boring and milling machine operators, die sinkers and patternmakers who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Building, Cleveland, O.

Superintendent: Progressive manufacturers having foundry, pattern and machine shops employing 500 men, need a thoroughly experienced and systematic superintendent; machine shop training essential; foundry experience preferred; give full details, past and present record, naming employers; communications strictly confidential; only men with a record need apply; location Ohio. Box 688, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First-class diemaker, one familiar with sheet metal pressed work; must be sober and reliable; state age, references and wages expected. Steady work for right man. Box 707, AMERICAN MACHINIST.

Instructor in mechanical drawing; a Philadelphia institution has a vacancy for a college graduate in engineering; applicant must have some drawing-office experience, teaching experience not necessary, and be a good disciplinarian; state age, education, experience, with references and submit sample print; state salary expected. Box 724, AM. MACH.

Wanted—A good live agent in every shop or factory in the U. S. to sell one of the best known preparations for removing grease and grime from the hands without injury to the skin. Absolutely guaranteed. An agent can make from $5.00 to $25.00 over and above his regular salary. This is no fake. Write for free sample and agents' terms. The Klenzola Co., Erie, Pa.

VIRGINIA

A Virginia furnace wants two competent engineers for power house should have had experience with blowing engines, hoisting engines and air compressors. Address, "Virginia," AMERICAN MACHINIST.

WISCONSIN

Wanted—Good mechanical designers and detail draftsmen for machinery manufacturer located in Wisconsin. Box 564, AMER. MACH.

For Sale

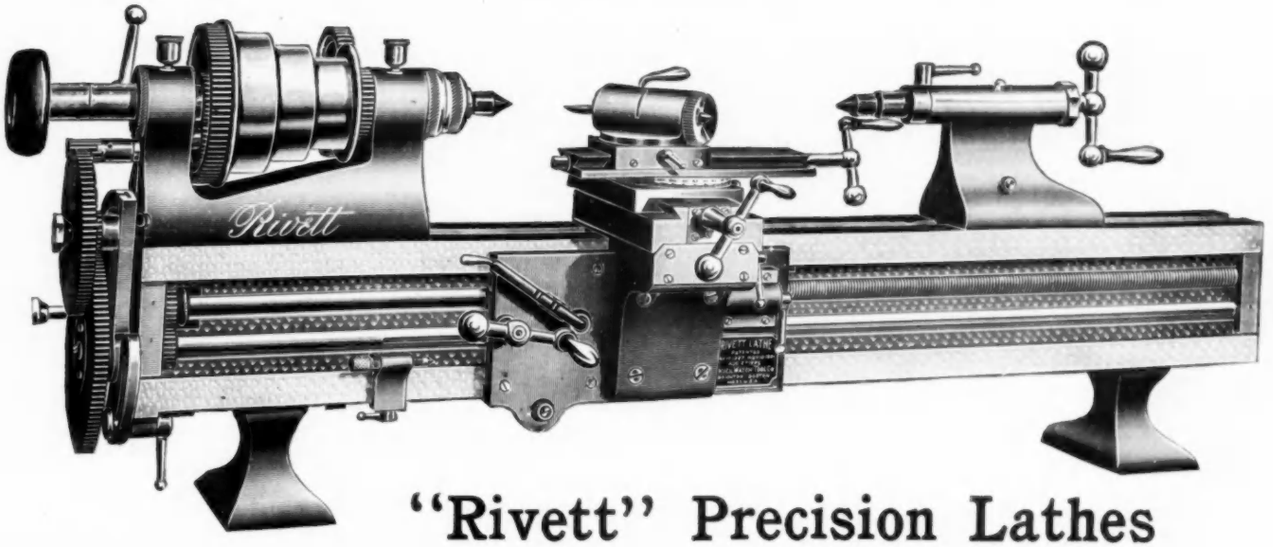
For Sale—Machine shop and foundry well equipped, successfully running under lease in best town in eastern Oregon; a rare bargain; $6000 cash, balance time. Box 679, AM. M.

For Sale, second-hand, one 12x24 Harris-Corliss engine and one 30-horsepower James Leffel & Co. high-speed engine; both in prime condition, and may be seen in operation; delivery December 1. Box 645, AMER. MACH.

For Sale—Modern new steel brick lined shop and tools, four years in operation; new tools, electric crane, gas engine and motor drive; running day and night since January; owners will retain part interest and give management to right party; located in Central West. Box 677, AMERICAN MACHINIST.

Alphabetical Index to Advertisers

	PAGE
Acme Machinery Co	118
Adams Co	95
Advance Machinery Co	105
Almond Mfg. Co., T. R	106
American Emery Wheel Wks	99
American Gas Furnace Co	109
American Pulley Co	101
American Saw Mill Machinery Co	101
American School of Correspondence	93
American Spiral Pipe Wks	98
American Swiss File and Tool Co	3d cover
American Tinol Co	111
American Tool Works Co	8
American Tube and Stamping Co	127
American Wood Working Machinery Co	112
Ames & Co., B. C	98
Armstrong-Blum Mfg. Co	98
Armstrong Bros. Tool Co	115
Automatic Machine Co	79
Baker Bros	95
Barnes Co., Wallace	116
Barnes Co., W. F. & John	14
Barnett Co., G. & H	59
Bath Grinder Co	77
Baush Machine Tool Co	31
Bay State Stamping Co	112
Beaman & Smith Co.	15 and 106
Becker Milling Machine Co.	23
Bemis & Call Hardware and Tool Co	111
Besly & Co., Chas. H	115
Betts Machine Co	6
Bignall & Keeler Mfg. Co	93
Bilgram Machine Wks	96
Billings & Spencer Co	112
Blaisdell Machinery Co	113
Blanchard Machine Co	120
Bliss Co., E. W	33
Blount Co., J. G	116
Boston Gear Works	96
Bradford Machine Tool Co	5
Bristol Co	4th cover
Brown & Co., R. H	106
Brown & Sharpe Mfg. Co., 86, 87 and 4th cover	
Browning & Co., Victor R	104
Brubaker & Bros., W. L	111
Buffalo Fdry. & Machine Co	98
Bullard Machine Tool Co	49
Butterfield & Co	111
Caldwell & Son Co., H. W	101
Carborundum Co	34
Card Mfg. Co., S. W	16
Carpenter Tap & Die Co., J. M.	116
Carter & Hakes Machine Co.	107
Chambersburg Engineering Co.	118
Champion Tool Works Co	111
Chicago Flexible Shaft Co	108
Chicago House Wrecking Co	91
Chicago Machine Tool Co	93
Chicago Raw Hide Mfg. Co	96
Cincinnati Bickford Tool Co.	10
Cincinnati Electrical Tool Co.	104
Cincinnati Gear Co	96
Cincinnati Gear Cutting Machine Co	128
Cincinnati Lathe & Tool Co.	105
Cincinnati Milling Machine Co	24 and 25
Cincinnati Planer Co	14
Cincinnati Shaper Co	128
Clark Cast Steel Cement Co.	110
Cleveland Auto. Mach. Co	18
Cleveland Crane & Engineering Co	100
Cleveland Planer Works	105
Cleveland Twist Drill Co., 4th cover	
Clough, R. M	111
Clum & Atkinson	110
Coates Clipper Mfg. Co	118
Coes Wrench Co	26
Consolidated Press and Tool Co	120
Cook Co., Asa S	111
Crocker-Wheeler Co	102
Crosby Steam Gage & Valve Co	17
Cumberland Steel Co	110
Curtis & Curtis Co	113
Cushman Chuck Co	106
Cushman Electric Co	104
Davis Machine Co., W. P	83
Defiance Machine Wks	117
Detrick & Harvey Mach. Co	94
Diamond Chain & Mfg. Co	101
Diamond Machine Co	81
Diamond Saw & Stamping Works	105
Dickinson, Thos. L	50
Dietz Machine Works	98
Dill Slotter People	117
Disston & Sons, Inc., Henry	85
Dixon Crucible Co., Jos	119
Dreses Machine Tool Co	9
Drucklieb, C	113
Earle Gear & Mach. Co	97
Eastern Machinery Co	100
Electric Welding Products Co.	110
Electro Dynamic Co	104
Elmes Engineering Works, Chas. F	111
Errington, F. A	107
Evans Friction Cone Co	100
Excelsior Needle Co	118
Farrel Fdry. & Mach. Co	111
Fawcus Machine Co	98
Fay & Scott	50
Fay Machine Tool Co	125
Fellows Gear Shaper Co	32
Felton, Sibley & Co	105
Ferracute Machine Co	101
Firth-Sterling Steel Co	109
Fitchburg Machine Works	117
Flather Mfg. Co., E. J	98
Flather Planer Co., Mark	113
Foote-Burt Co	112
Fort Wayne Electric Wks	104
Fosdick Machine Tool Co	16
Foster Machine Co	105
Franklin Mfg. Co	110
Gang Co., W. E	93
Gardner Machine Co	99
Garwood Electric Co	103
Gem Mfg. Co	119
General Electric Co	102
Geometric Tool Co	27
Gisholt Machine Co	123
Gorton Machine Co., Geo	120
Gould & Eberhardt	115
Graham Mfg. Co	107
Grant Gear Works	96
Grant Mfg. & Mach. Co	120
Graton & Knight Mfg. Co	92
Gray Co., G. A	28
Greaves, Klusman & Co	119
Greene, Tweed & Co	117
Gronkvist Drill Chuck Co	107
Hammacher, Schlemmer & Co.	73
Hardinge Bros	105
Harrington, Son & Co., Edw.	128
Hart & Cooley Co	125
Hendey Machine Co	75
Henry & Wright Mfg. Co	125
Hess-Bright Mfg. Co	93
Hisey-Wolf Machine Co	102
Hoefer Mfg. Co	124
Hoggson & Pettis Mfg. Co	106
Horsburgh & Scott Co	98
Horton & Son Co., E	106
Hoskins Mfg. Co	110
Hurlbut-Rogers Machine Co.	111
Independent Pneumatic Tool Co	113
Industrial Oxygen Co	108
Ingersoll Milling Machine Co.	17
Ingersoll-Rand Co	113
International Acheson Graphite Co	127
Jacobs Mfg. Co	107
Jefferson Union Co	119
Johnson Machine Co., Carlyle.	115
Jones & Lamson Mach. Co., 12, 13 and 50	
Kearney & Trecker Co	26
Kelly Co., R. A	121
Kempsmith Mfg. Co	22
Kern Machine Tool Co	121
Keuffel & Esser Co	89
Knowles, L. B	92



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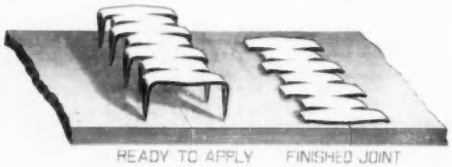

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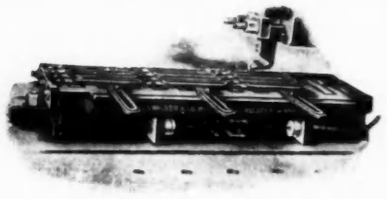

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